



## Durham E-Theses

---

# *The aerodynamics of curved jets and breakaway in Coanda flares*

Senior, Peter

### How to cite:

---

Senior, Peter (1991) *The aerodynamics of curved jets and breakaway in Coanda flares*, Durham theses, Durham University. Available at Durham E-Theses Online: <http://etheses.dur.ac.uk/6199/>

### Use policy

---

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in Durham E-Theses
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full Durham E-Theses policy](#) for further details.

# The Aerodynamics of Curved Jets and Breakaway in Coanda Flares

Volume 2 of 2

*Peter Senior*

The copyright of this thesis rests with the author.  
No quotation from it should be published without  
his prior written consent and information derived  
from it should be acknowledged.

University of Durham  
School of Engineering and Applied Science

Thesis submitted AD 1991 for  
the Degree of Doctor of Philosophy



10 FEB 1992

## List of Figures

- Figure 1.1 Coanda Flare Variants
- Figure 2.1 Coanda Flare Flowfield Schematic
- Figure 2.2 Shock–Boundary Layer Interactions
- Figure 4.1 Method of Characteristics Unit Processes
- Figure 4.2 Expansion Corner MoC Unit Process
- Figure 4.3 Shocked MoC Unit Process
- Figure 4.4 Edge Shock Reflection MoC Unit Processes
- Figure 4.5 Boundary Layer Marching Test Case
- Figure 4.6 Comparison of MoC with Boundary Layer Method
- Figure 5.1 Mechanical Rig Suspension
- Figure 5.2 Mechanical Rig Leg Tube
- Figure 5.3 Planar Flare Model
- Figure 5.4 Axisymmetric Flare Model
- Figure 5.5 Axisymmetric Flare Support
- Figure 5.6 Air Supply Layout
- Figure 6.1 Optical Apparatus Planar Build
- Figure 6.2 Optical Apparatus Axisymmetric Build
- Figure 6.3 Flare Model Surface Flow Visualisation Photography Layout
- Figure 6.4 Manometer Tube Photography
- Figure 7.1.1 Planar Coanda Model Breakaway Behaviour
- Figure 7.1.2 Planar Coanda Model Reversion Behaviour
- Figure 7.1.3 Planar Coanda Model Partial Reversion Behaviour
- Figure 7.1.4 Planar Coanda Model Breakaway/Reversion Behaviour
- Figure 7.1.5 Interferometry Fringe Pattern – Choking
- Figure 7.1.6 Interferometry Density Contours – Choking
- Figure 7.1.7 Interferometry Pressure Contours – Choking
- Figure 7.1.8 Interferometry Mach Number Contours – Choking
- Figure 7.1.9 Interferometry Density Contours – Underexpanding
- Figure 7.1.10 Interferometry Pressure Contours – Underexpanding
- Figure 7.1.11 Interferometry Mach Number Contours – Underexpanding

- Figure 7.1.12 Planar Coanda Model Experimental Surface Pressures:  
Slot 2.00 mm, Step 0.00 mm
- Figure 7.1.13 Planar Coanda Model Experimental Surface Pressures:  
Slot 2.00 mm, Step 0.75 mm
- Figure 7.1.14 Planar Coanda Model Experimental Surface Pressures:  
Slot 2.00 mm, Step 1.50 mm
- Figure 7.1.15 Planar Coanda Model Experimental Surface Pressures:  
Slot 2.00 mm, Step 1.50 mm
- Figure 7.1.16 Planar Coanda Model Experimental Surface Pressures:  
Slot 4.00 mm, Step 0.00 mm
- Figure 7.1.17 Planar Coanda Model Experimental Surface Pressures:  
Slot 4.00 mm, Step 0.75 mm
- Figure 7.1.18 Planar Coanda Model Experimental Surface Pressures:  
Slot 4.00 mm, Step 1.50 mm
- Figure 7.1.19 Planar Coanda Model Experimental Surface Pressures:  
Slot 4.00 mm, Step 1.50 mm
- Figure 7.1.20 Planar Coanda Model Experimental Surface Pressures:  
Slot 4.00 mm, Step 2.55 mm
- Figure 7.1.21 Planar Coanda Model Experimental Surface Pressures:  
Slot 4.00 mm, Step 3.76 mm
- Figure 7.1.22 Planar Coanda Model Experimental Surface Pressures:  
Slot 4.00 mm, Step 3.76 mm
- Figure 7.1.23 Planar Coanda Model Experimental Surface Pressures:  
Slot 6.00 mm, Step 0.00 mm
- Figure 7.1.24 Planar Coanda Model Experimental Surface Pressures:  
Slot 6.00 mm, Step 0.75 mm
- Figure 7.1.25 Planar Coanda Model Experimental Surface Pressures:  
Slot 6.00 mm, Step 1.50 mm
- Figure 7.1.26 Planar Coanda Model Experimental Surface Pressures:  
Slot 6.00 mm, Step 3.75 mm
- Figure 7.1.27 Planar Coanda Model Experimental Surface Pressures:  
Slot 8.00 mm, Step 0.00 mm
- Figure 7.1.28 Planar Coanda Model Experimental Surface Pressures:  
Slot 8.00 mm, Step 0.75 mm
- Figure 7.1.29 Planar Coanda Model Experimental Surface Pressures:  
Slot 8.00 mm, Step 1.50 mm
- Figure 7.1.30 Planar Coanda Model Experimental Surface Pressures:  
Slot 8.00 mm, Step 3.75 mm
- Figure 7.1.31 Planar Flare Model Endwall Flow
- Figure 7.2.1 Planar Coanda Model Base Pressures: Slot 2.00 mm
- Figure 7.2.2 Planar Coanda Model Base Pressures: Slot 4.00 mm
- Figure 7.2.3 Planar Coanda Model Base Pressures: Slot 6.00 mm
- Figure 7.2.4 Planar Coanda Model Base Pressures: Slot 8.00 mm

- Figure 7.2.5 Planar Coanda Model Method of Characteristics Plot:  
Slot 2.00 mm, Step 0.00 mm,  $C_{po} = 0.243$
- Figure 7.2.6 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.324$
- Figure 7.2.7 Planar Coanda Model Method of Characteristics Plot:  
Slot 6.00 mm, Step 0.00 mm,  $C_{po} = 0.366$
- Figure 7.2.8 Planar Coanda Model Method of Characteristics Plot:  
Slot 8.00 mm, Step 0.00 mm,  $C_{po} = 0.425$
- Figure 7.2.9 Planar Coanda Model Method of Characteristics Plot:  
Slot 2.00 mm, Step 0.00 mm,  $C_{po} = 0.243$
- Figure 7.2.10 Planar Coanda Model Method of Characteristics Plot:  
Slot 2.00 mm, Step 0.00 mm,  $C_{po} = 0.176$
- Figure 7.2.11 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.324$
- Figure 7.2.12 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.256$
- Figure 7.2.13 Planar Coanda Model Method of Characteristics Plot:  
Slot 6.00 mm, Step 0.00 mm,  $C_{po} = 0.366$
- Figure 7.2.14 Planar Coanda Model Method of Characteristics Plot:  
Slot 6.00 mm, Step 0.00 mm,  $C_{po} = 0.330$
- Figure 7.2.15 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 1.50 mm,  $C_{po} = 0.331$
- Figure 7.2.16 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 1.50 mm,  $C_{po} = 0.331$
- Figure 7.2.17 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 1.50 mm,  $C_{po} = 0.331$
- Figure 7.2.18 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 1.50 mm,  $C_{po} = 0.212$
- Figure 7.2.19 Planar Coanda Model Method of Characteristics Plot:  
Slot 2.00 mm, Step 0.00 mm,  $C_{po} = 0.258$
- Figure 7.2.20 Planar Coanda Model Method of Characteristics Plot:  
Slot 2.00 mm, Step 0.00 mm,  $C_{po} = 0.243$
- Figure 7.2.21 Planar Coanda Model Method of Characteristics Plot:  
Slot 2.00 mm, Step 0.00 mm,  $C_{po} = 0.176$
- Figure 7.2.22 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.355$
- Figure 7.2.23 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.324$
- Figure 7.2.24 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.324$
- Figure 7.2.25 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.277$
- Figure 7.2.26 Planar Coanda Model Method of Characteristics Plot:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.256$
- Figure 7.2.27 Planar Coanda Model Method of Characteristics Plot:  
Slot 6.00 mm, Step 0.00 mm,  $C_{po} = 0.366$

- Figure 8.2.1 Axisymmetric Coanda Model Base Pressures: Slot 1.67 mm
- Figure 8.2.2 Axisymmetric Coanda Model Base Pressures: Slot 2.54 mm
- Figure 8.2.3 Axisymmetric Coanda Model Base Pressures: Slot 3.33 mm
- Figure 8.2.4 Axisymmetric Coanda Model Base Pressures: Slot 5.00 mm
- Figure 8.2.5 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 3.33.00 mm, Step 0.00 mm,  $C_{po} = 0.174$
- Figure 8.2.6 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 1.67.00 mm, Step 0.00 mm,  $C_{po} = 0.202$
- Figure 8.2.7 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 1.67.00 mm, Step 0.00 mm,  $C_{po} = 0.124$
- Figure 8.2.8 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 3.33.00 mm, Step 0.00 mm,  $C_{po} = 0.265$
- Figure 8.2.9 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 3.33.00 mm, Step 0.00 mm,  $C_{po} = 0.265$
- Figure 8.2.10 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 3.33.00 mm, Step 0.00 mm,  $C_{po} = 0.233$
- Figure 8.2.11 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 3.33.00 mm, Step 0.00 mm,  $C_{po} = 0.174$
- Figure 8.2.12 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 5.00.00 mm, Step 0.00 mm,  $C_{po} = 0.225$
- Figure 8.2.13 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 2.54.00 mm, Step 1.25 mm,  $C_{po} = 0.163$
- Figure 8.2.14 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 2.54.00 mm, Step 1.25 mm,  $C_{po} = 0.125$
- Figure 8.2.15 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 1.67.00 mm, Step 0.00 mm,  $C_{po} = 0.202$
- Figure 8.2.16 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 1.67.00 mm, Step 0.00 mm,  $C_{po} = 0.124$
- Figure 8.2.17 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 3.33.00 mm, Step 0.00 mm,  $C_{po} = 0.233$
- Figure 8.2.18 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 3.33.00 mm, Step 0.00 mm,  $C_{po} = 0.174$
- Figure 8.2.19 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 5.00.00 mm, Step 0.00 mm,  $C_{po} = 0.314$
- Figure 8.2.20 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 5.00.00 mm, Step 0.00 mm,  $C_{po} = 0.225$
- Figure 8.2.21 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 2.54.00 mm, Step 1.25 mm,  $C_{po} = 0.125$
- Figure 8.2.22 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 2.54.00 mm, Step 1.25 mm,  $C_{po} = 0.125$
- Figure 8.2.23 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 6.65.00 mm, Step 0.55 mm,  $C_{po} = 0.252$
- Figure 8.2.24 Axisymmetric Coanda Model Method of Characteristics Plot:  
Slot 6.65.00 mm, Step 3.60 mm,  $C_{po} = 0.184$

## List of Plates

- Plate 1a Planar Coanda Model Shadowgraph:  
Slot 2.00 mm, Step 0.00 mm,  $C_{po} = 0.176$
- Plate 1b Planar Coanda Model Shadowgraph:  
Slot 2.00 mm, Step 1.50 mm,  $C_{po} = 0.124$
- Plate 2a Planar Coanda Model Interferometry Fringes:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.000$
- Plate 2b Planar Coanda Model Interferometry Fringes:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.488$
- Plate 3a Planar Coanda Model Shadowgraph:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.325$
- Plate 3b Planar Coanda Model Spark Schlieren: Vertical Knife Edge  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.256$
- Plate 4a Planar Coanda Model Surface Flow Visualisation:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.324$
- Plate 4b Planar Coanda Model Surface Flow Visualisation:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.256$
- Plate 5a Planar Coanda Model Interferometry Fringes:  
Slot 4.00 mm, Step 0.00 mm,  $C_{po} = 0.312$
- Plate 5b Planar Coanda Model Interferometry Fringes:  
Slot 4.00 mm, Step 1.50 mm,  $C_{po} = 0.331$
- Plate 6a Planar Coanda Model Surface Flow Visualisation:  
Slot 4.00 mm, Step 1.50 mm,  $C_{po} = 0.331$
- Plate 6b Planar Coanda Model Surface Flow Visualisation:  
Slot 4.00 mm, Step 1.50 mm,  $C_{po} = 0.256$
- Plate 7a Planar Coanda Model Schlieren: Horizontal Knife Edge  
Slot 4.00 mm, Step 1.50 mm,  $C_{po} = 0.212$
- Plate 7b Planar Coanda Model Schlieren: Vertical Knife Edge  
Slot 4.00 mm, Step 2.55 mm,  $C_{po} = 0.205$
- Plate 8a Planar Coanda Model Shadowgraph:  
Slot 4.00 mm, Step 3.76 mm,  $C_{po} = 0.228$

- Plate 8b Planar Coanda Model Spark Schlieren: Vertical Knife Edge  
Slot 4.00 mm, Step 3.76 mm,  $C_{po} = 0.191$
- Plate 9a Planar Coanda Model Schlieren: Vertical Knife Edge  
Slot 6.00 mm, Step 1.50 mm,  $C_{po} = 0.290$
- Plate 9b Planar Coanda Model Schlieren: Vertical Knife Edge  
Slot 6.00 mm, Step 3.75 mm,  $C_{po} = 0.315$
- Plate 10a Planar Coanda Model Schlieren: Horizontal Knife Edge  
Slot 8.00 mm, Step 1.49 mm,  $C_{po} = 0.359$
- Plate 10b Axisymmetric Coanda Model Schlieren: Horizontal Knife Edge  
Slot 5.00 mm, Step 1.25 mm,  $C_{po} = 0.207$
- Plate 11a Axisymmetric Coanda Model Schlieren: Horizontal Knife Edge  
Slot 1.67 mm, Step 0.00 mm,  $C_{po} = 0.124$
- Plate 11b Axisymmetric Coanda Model Schlieren: Vertical Knife Edge  
Slot 1.67 mm, Step 1.25 mm,  $C_{po} = 0.105$
- Plate 12a Axisymmetric Coanda Model Spark Schlieren: Horizontal Knife Edge  
Slot 2.54 mm, Step 1.25 mm,  $C_{po} = 0.125$
- Plate 12b Axisymmetric Coanda Model Schlieren: Horizontal Knife Edge  
Slot 3.33 mm, Step 0.00 mm,  $C_{po} = 0.265$
- Plate 13a Axisymmetric Coanda Model Surface Flow Visualisation:  
Slot 2.54 mm, Step 1.25 mm,  $C_{po} = 0.125$
- Plate 13b Axisymmetric Coanda Model Surface Flow Visualisation:  
Slot 3.33 mm, Step 0.00 mm,  $C_{po} = 0.174$
- Plate 14a Axisymmetric Coanda Model Spark Schlieren: Horizontal Knife Edge  
Slot 3.33 mm, Step 0.00 mm,  $C_{po} = 0.174$
- Plate 14b Axisymmetric Coanda Model Schlieren: Vertical Knife Edge  
Slot 3.33 mm, Step 0.00 mm,  $C_{po} = 0.243$
- Plate 15a Axisymmetric Coanda Model Surface Flow Visualisation:  
Slot 3.33 mm, Step 1.25 mm,  $C_{po} = 0.209$
- Plate 15b Axisymmetric Coanda Model Surface Flow Visualisation:  
Slot 3.33 mm, Step 1.25 mm,  $C_{po} = 0.174$
- Plate 16a Axisymmetric Coanda Model Schlieren: Vertical Knife Edge  
Slot 3.33 mm, Step 1.25 mm,  $C_{po} = 0.157$
- Plate 16b Axisymmetric Coanda Model Spark Schlieren: Vertical Knife Edge  
Slot 3.33 mm, Step 3.13 mm,  $C_{po} = 0.159$
- Plate 17a Axisymmetric Coanda Model Schlieren: Vertical Knife Edge  
Slot 5.00 mm, Step 0.00 mm,  $C_{po} = 0.225$
- Plate 17b Axisymmetric Coanda Model Shadowgraph:  
Slot 5.00 mm, Step 3.13 mm,  $C_{po} = 0.222$



- Plate 18a I8 Coanda Model (Field Tests) Shadowgraph:  
Slot 6.65 mm, Step 0.55 mm,  $C_{po}=0.252$
- Plate 18b I8 Coanda Model (Field Tests) Shadowgraph:  
Slot 6.65 mm, Step 3.60 mm,  $C_{po}=0.184$
- Plate 19 I8 Coanda Model (Field Tests) Surface Flow Visualisation:  
Slot 6.65 mm, Step 3.60 mm,  $C_{po}=0.184$

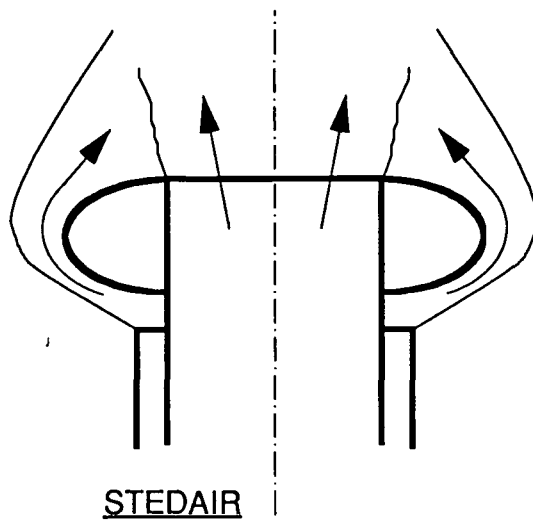
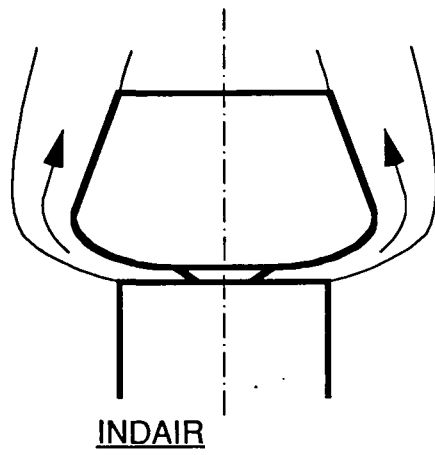
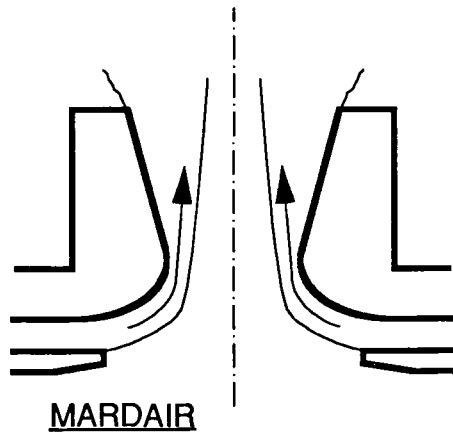


Figure 1.1. Coanda Flare Variants



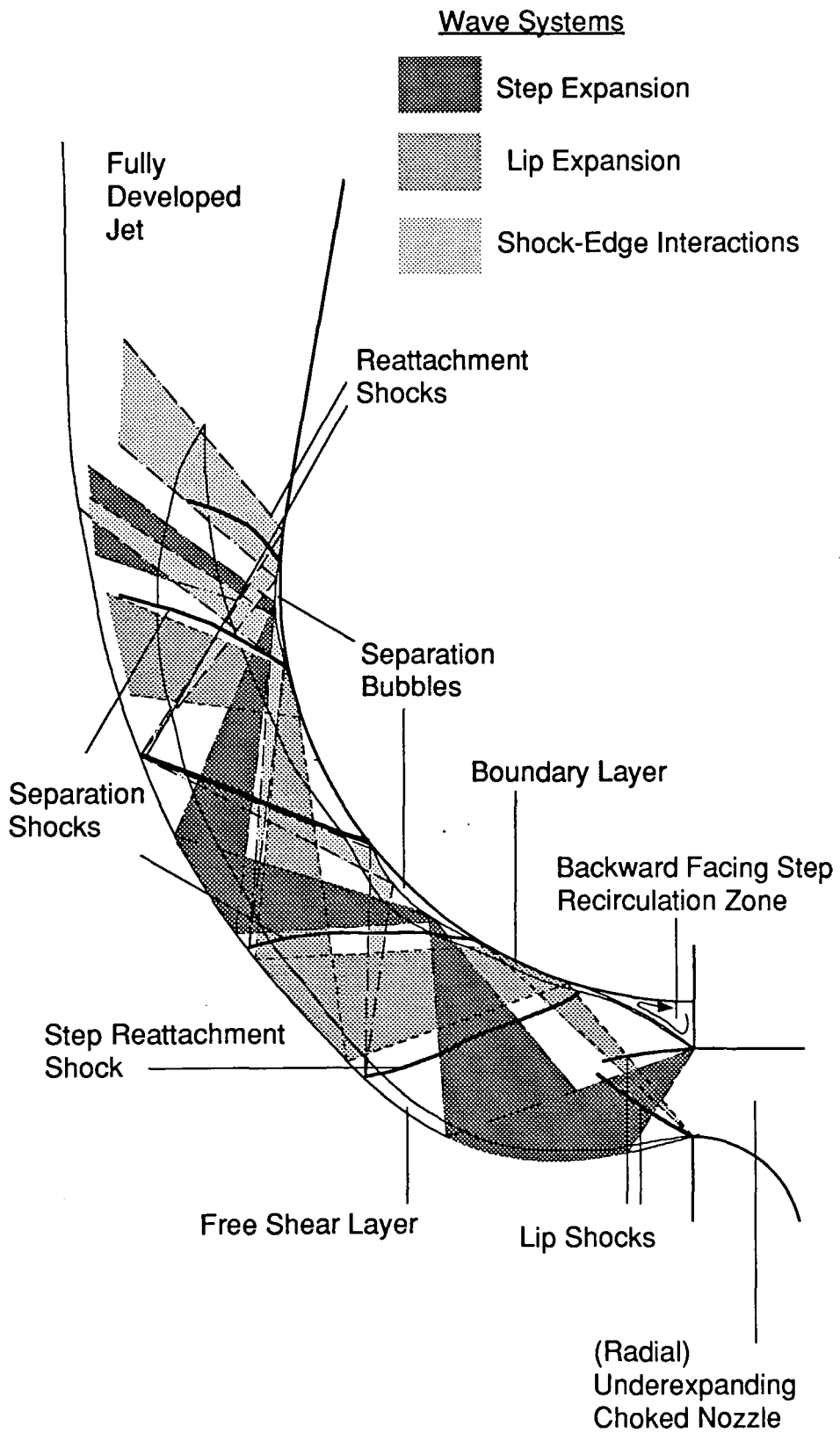
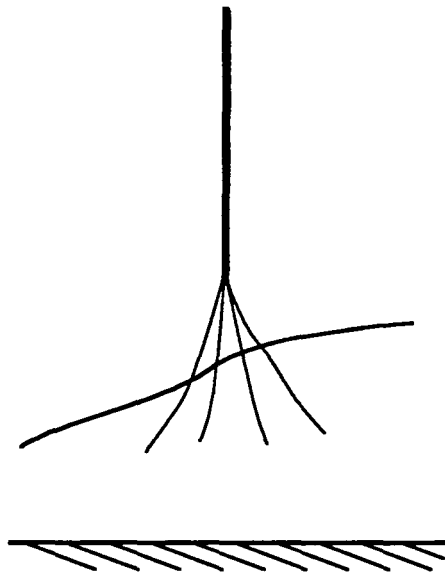
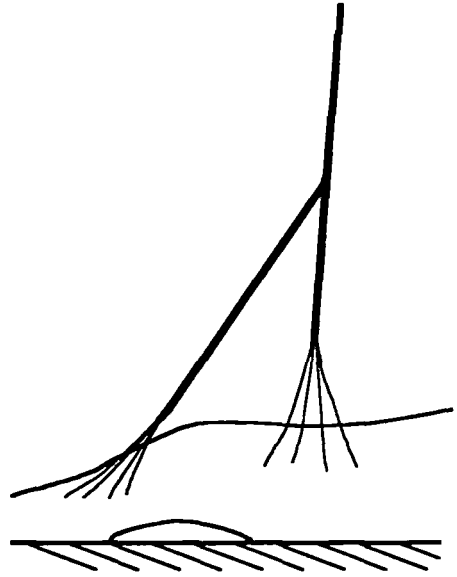


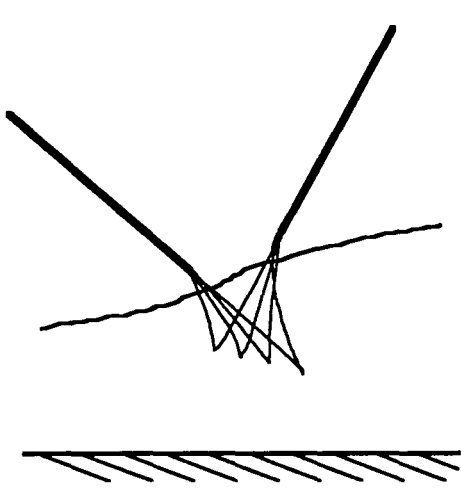
Figure 2.1. Coanda Flare Flowfield Schematic



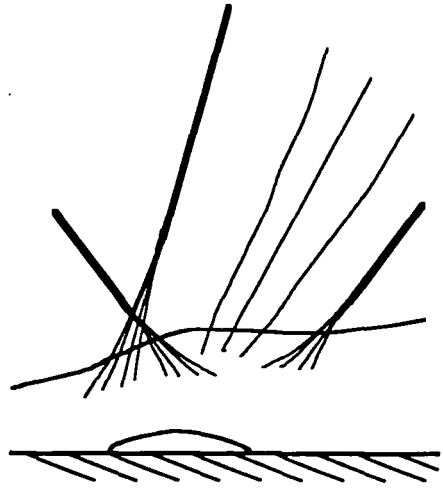
a) Normal, Attached



b) Normal, Separated



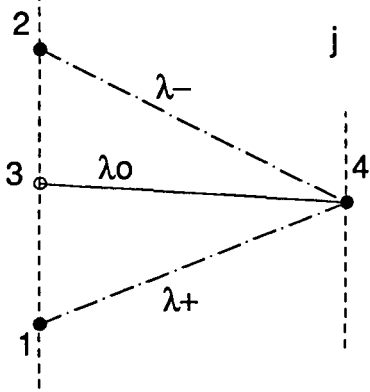
c) Oblique, Attached



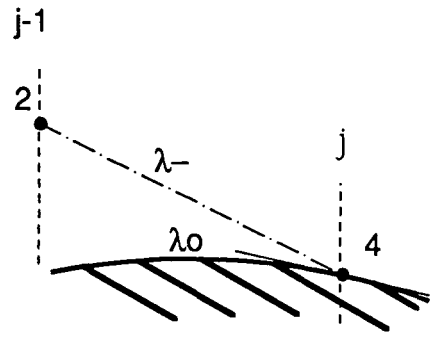
d) Oblique, Separated

Figure 2.2. Shock-Boundary Layer Interactions

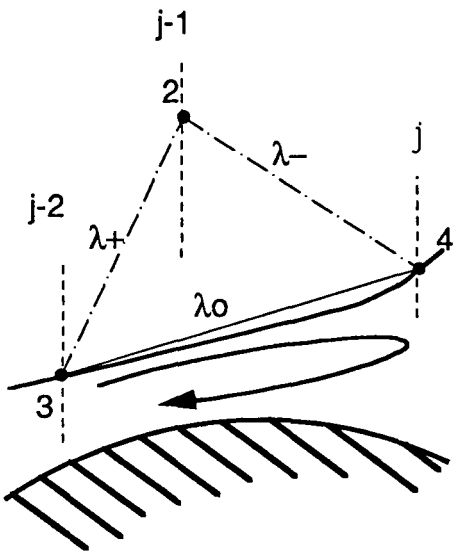
Step  $j-1$



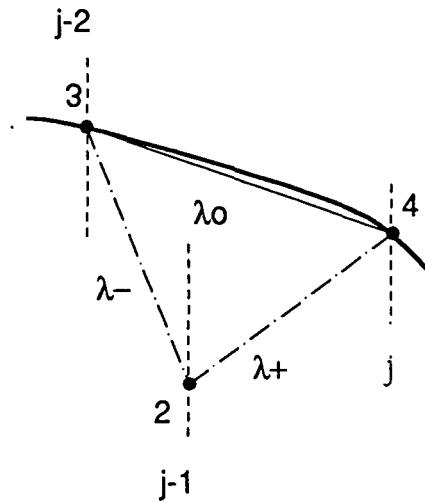
a) Flow Internal



b) Attached Inner Edge



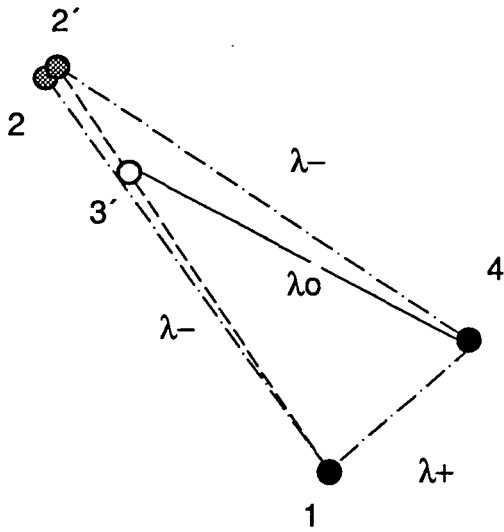
c) Separated Inner Edge



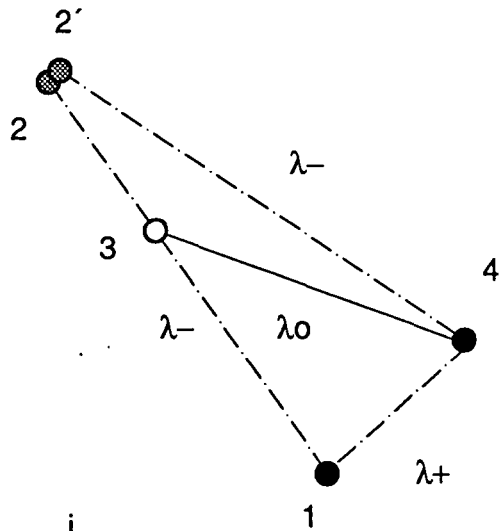
d) Outer Edge

- Solution Points
- Interpolated Points

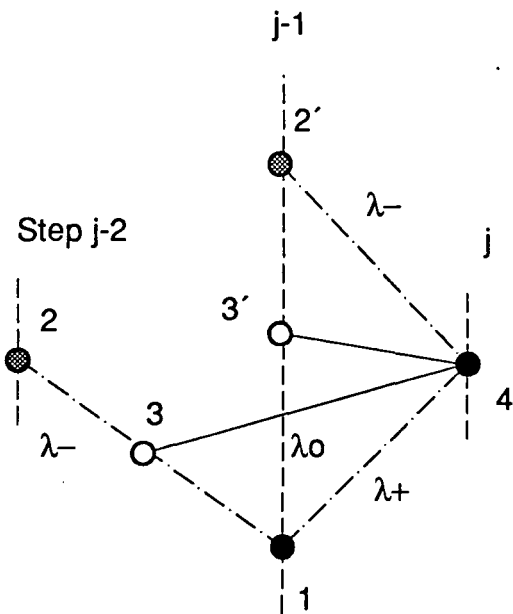
Figure 4.1. Method of Characteristics Unit Processes



a) Incorrect Physical



b) Correct Physical



c) Computational

- MoC Solution Point
- ⊙ Calculated Fan Point
- Interpolated Point

Figure 4.2. Expansion Corner MoC Unit Process

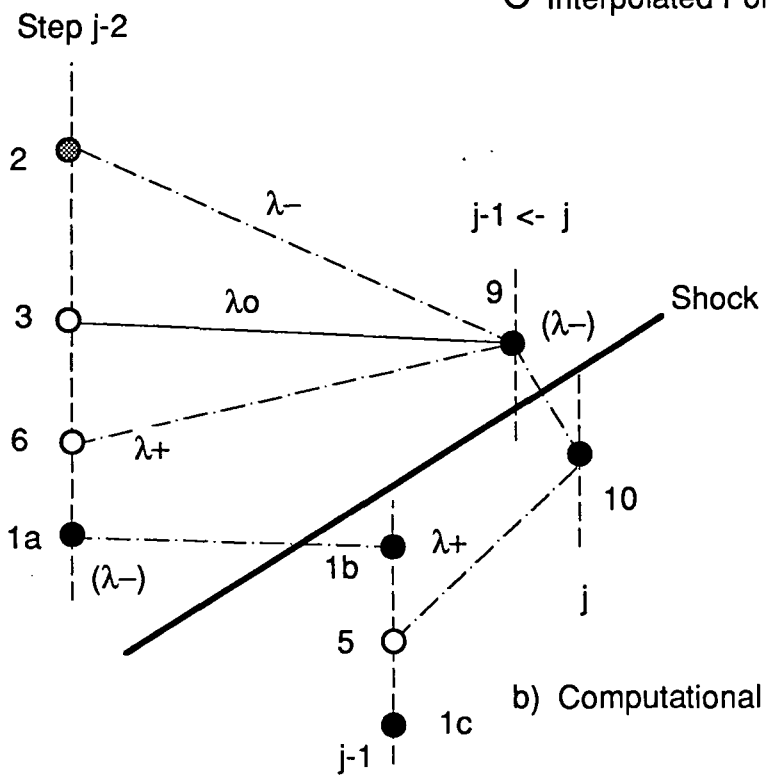
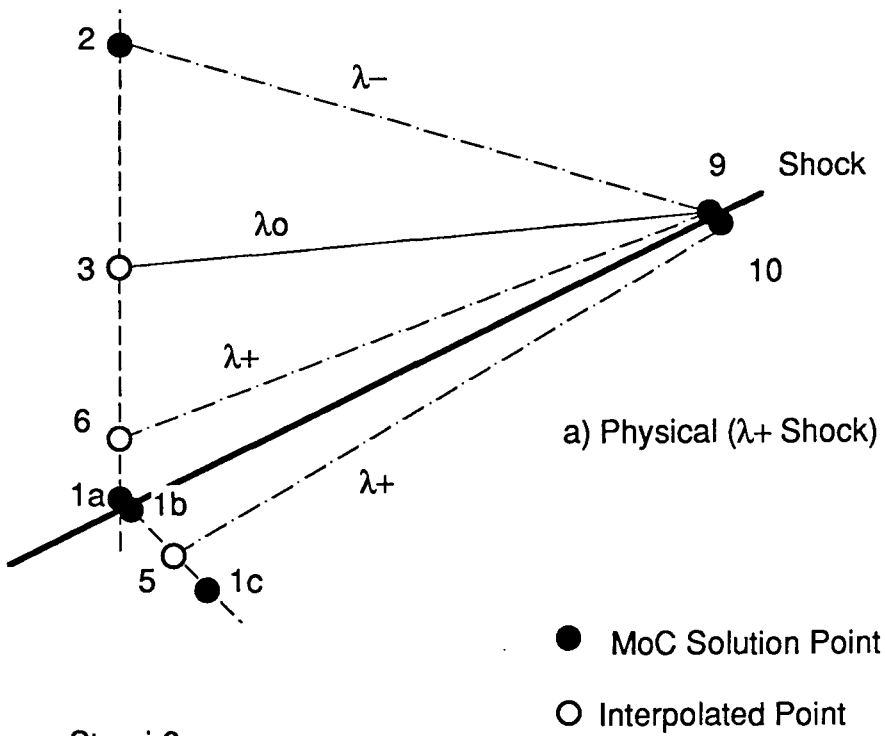
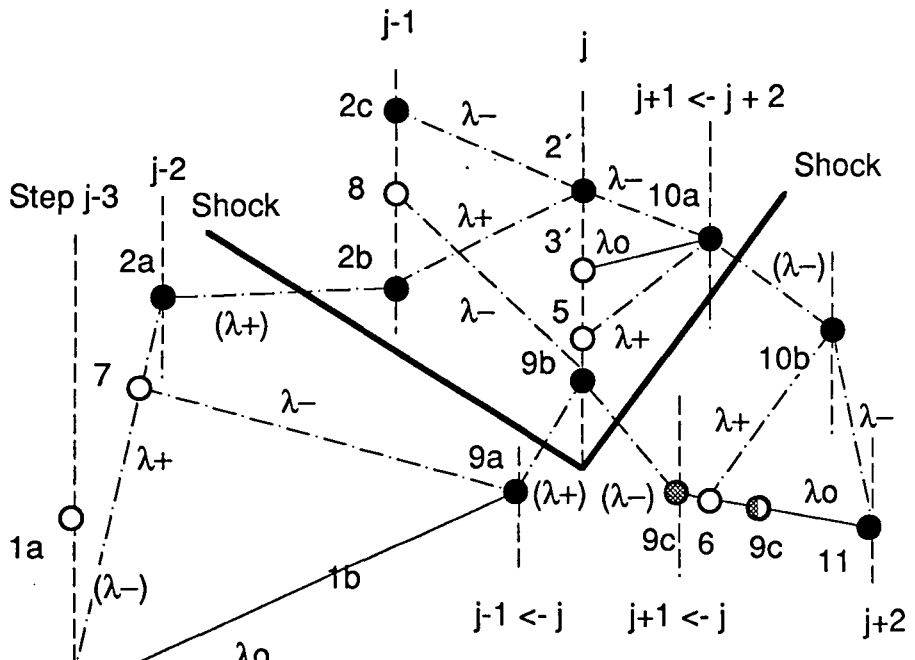
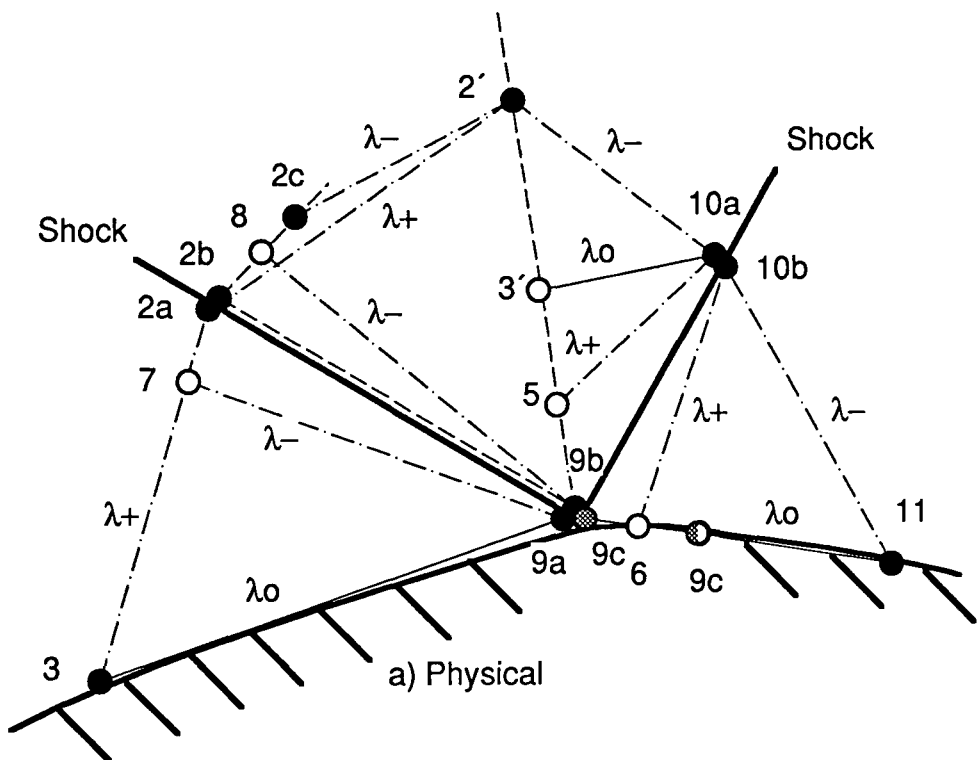


Figure 4.3. Shocked MoC Unit Process



- b) Computational
- MoC Solution Point
  - ⊙ Calculated Solution Point
  - Interpolated Point

Figure 4.4. Edge Shock Reflection MoC Unit Processes



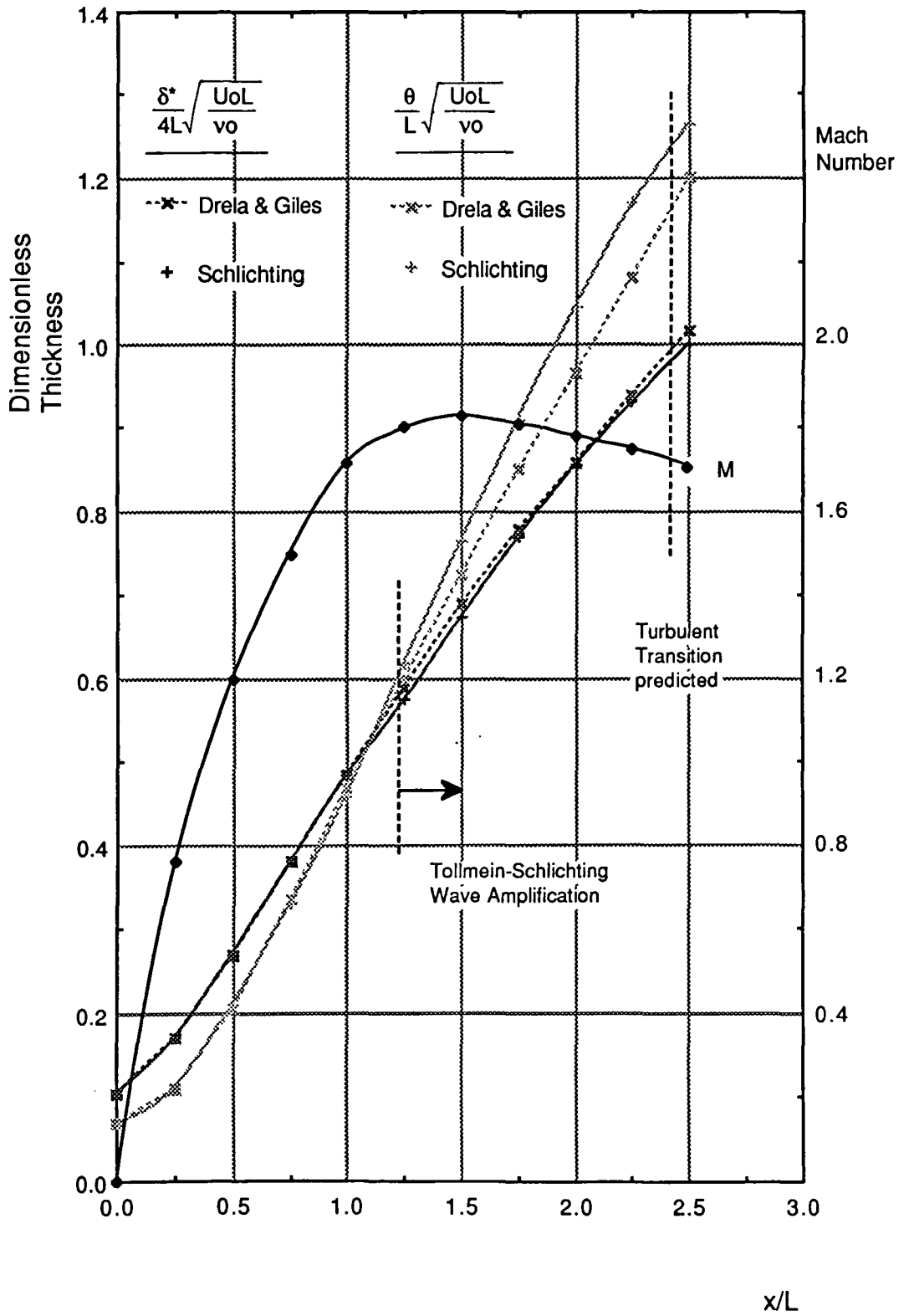


Figure 4.5. Boundary Layer Marching Test Case

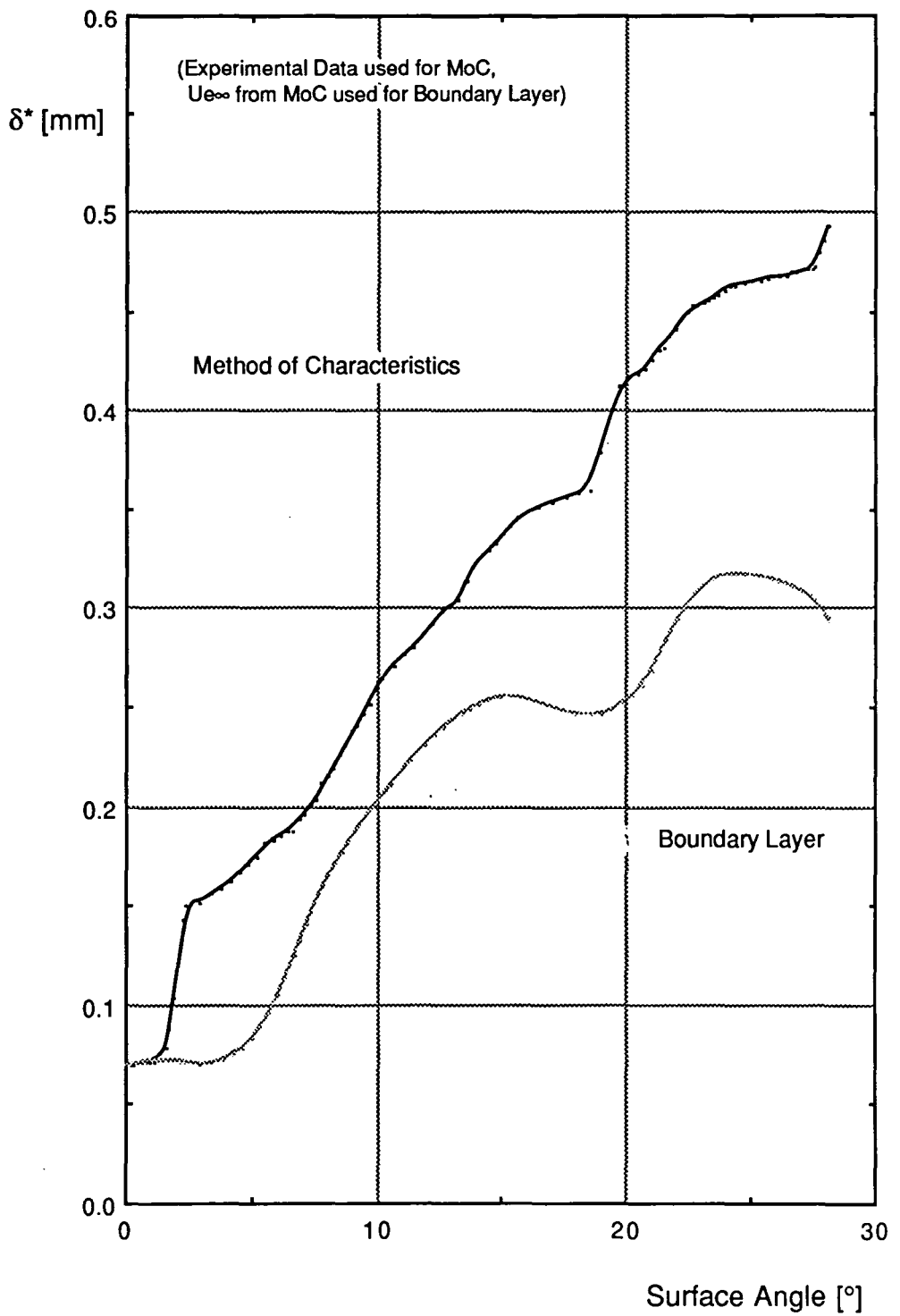


Figure 4.6. Comparison of Method of Characteristics with Boundary Layer Method

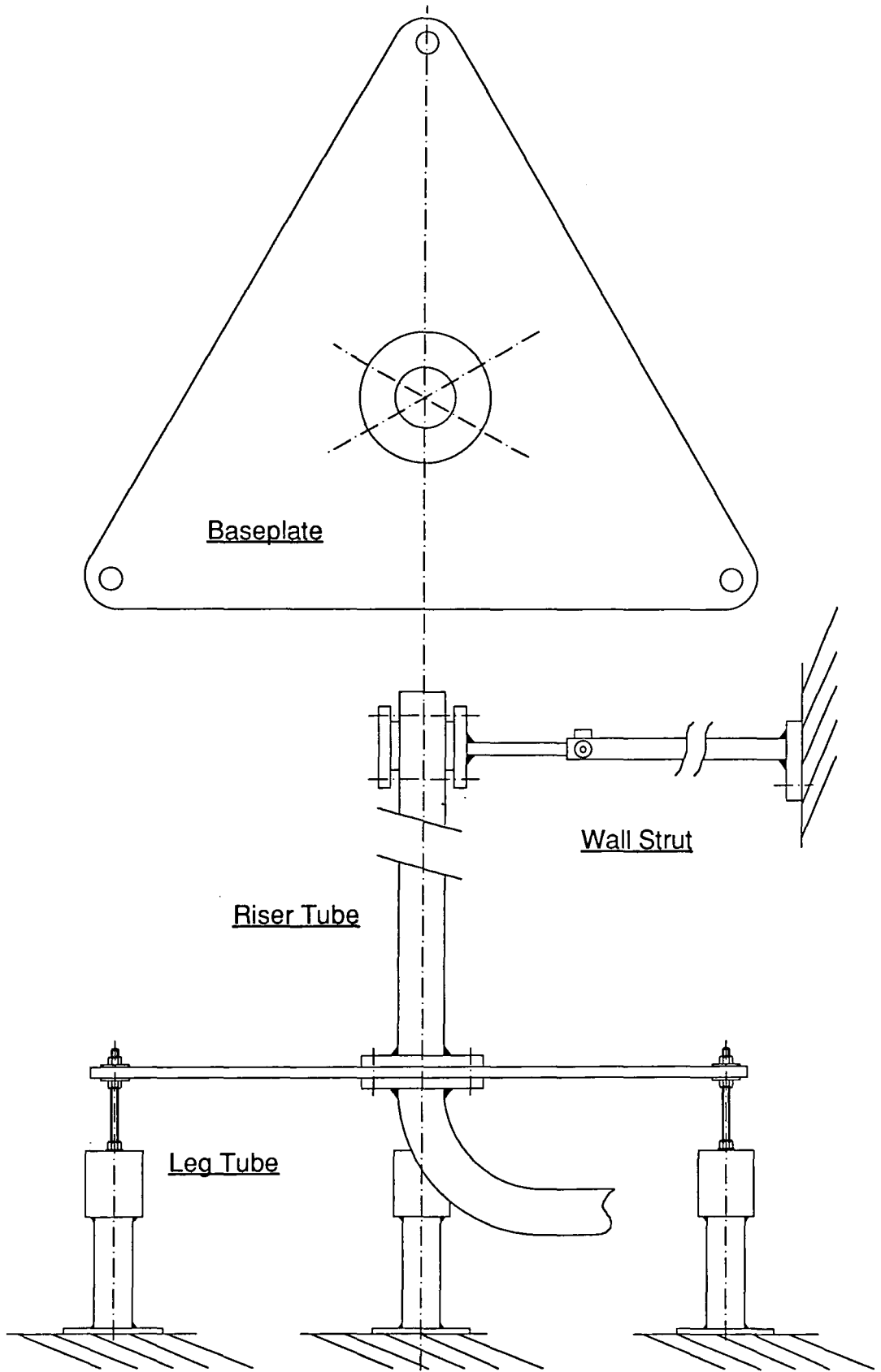
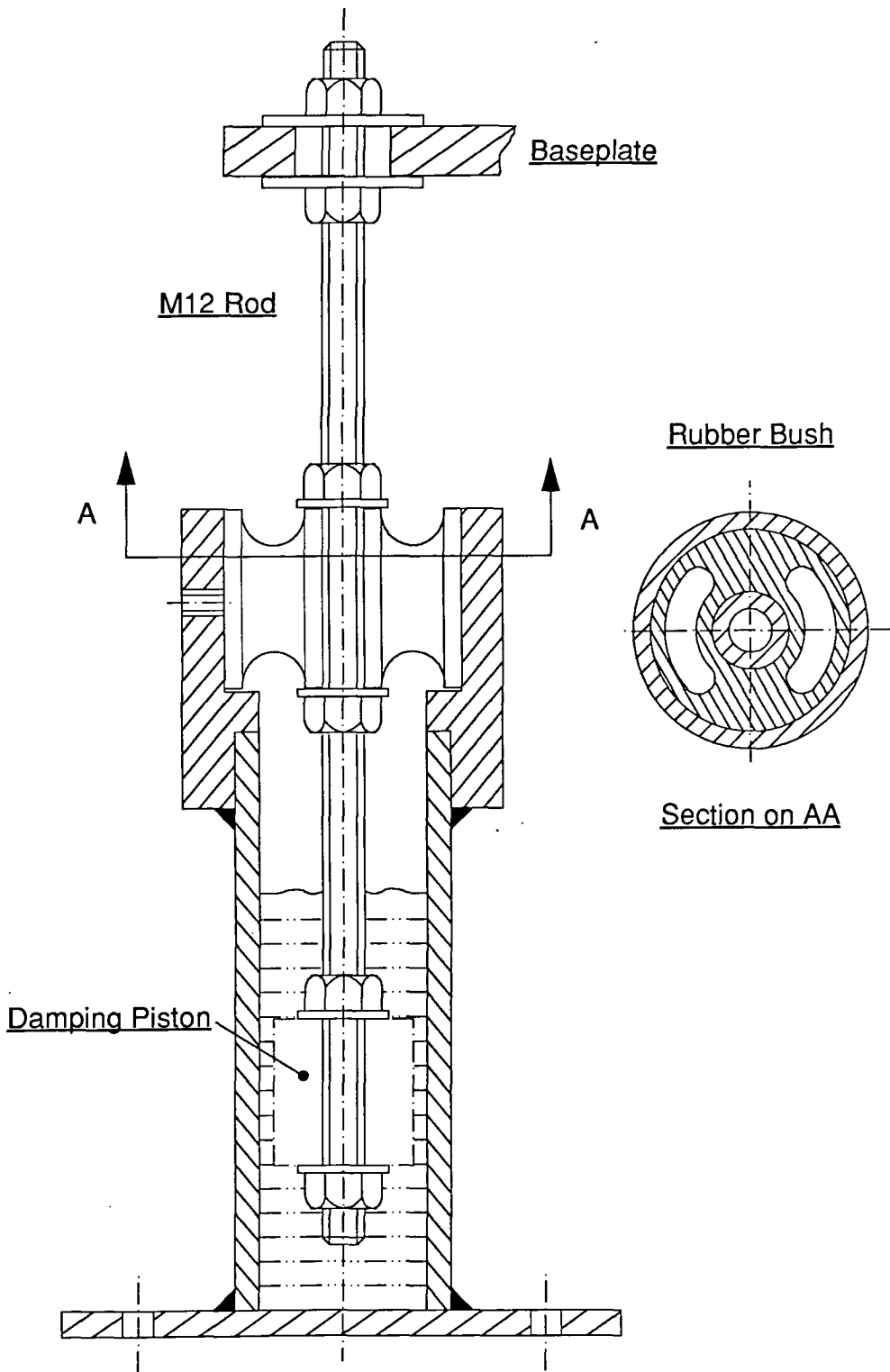


Figure 5.1. Mechanical Rig Suspension



**Figure 5.2. Mechanical Rig Leg Tube**

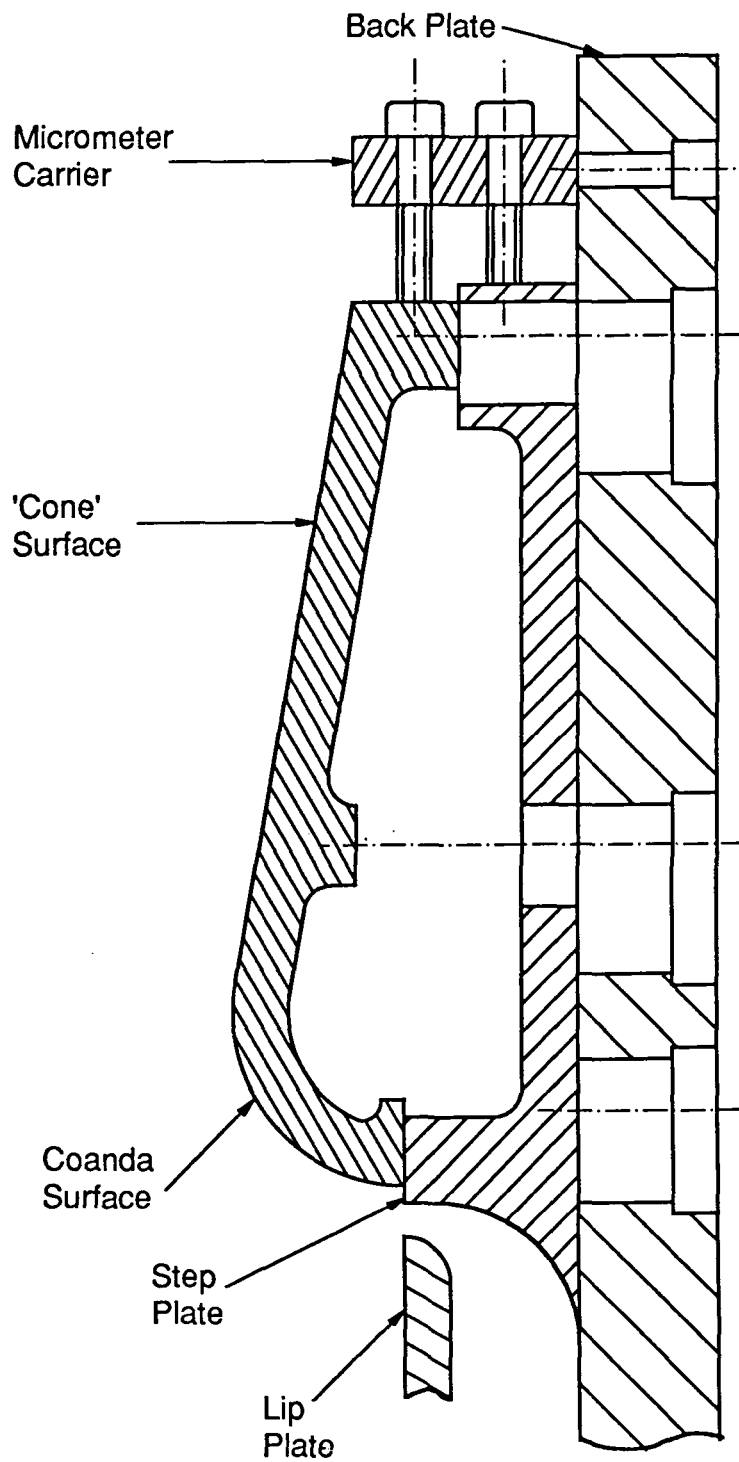


Figure 5.3. Planar Flare Model

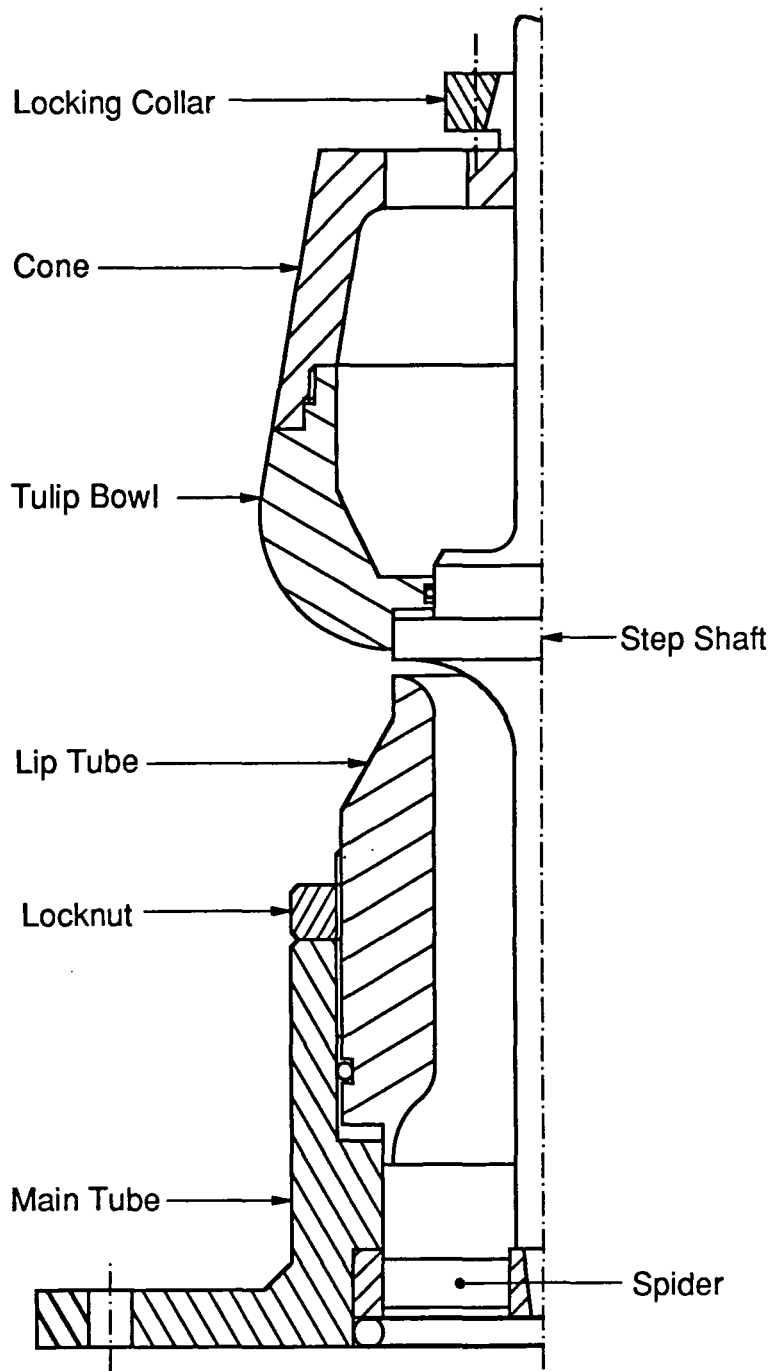
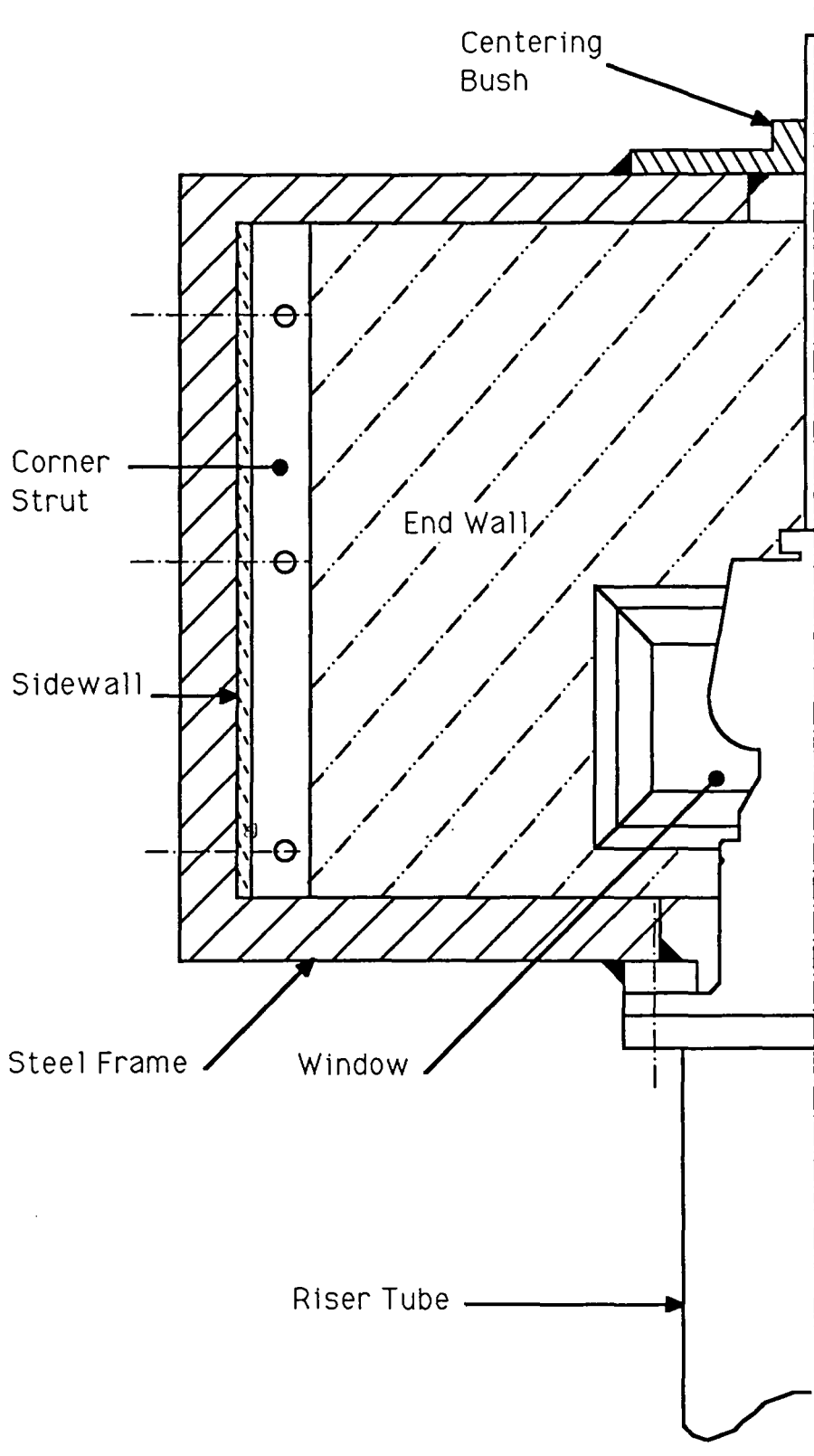


Figure 5.4. Axisymmetric Flare Model



**Figure 5.5. Axisymmetric Flare Support**

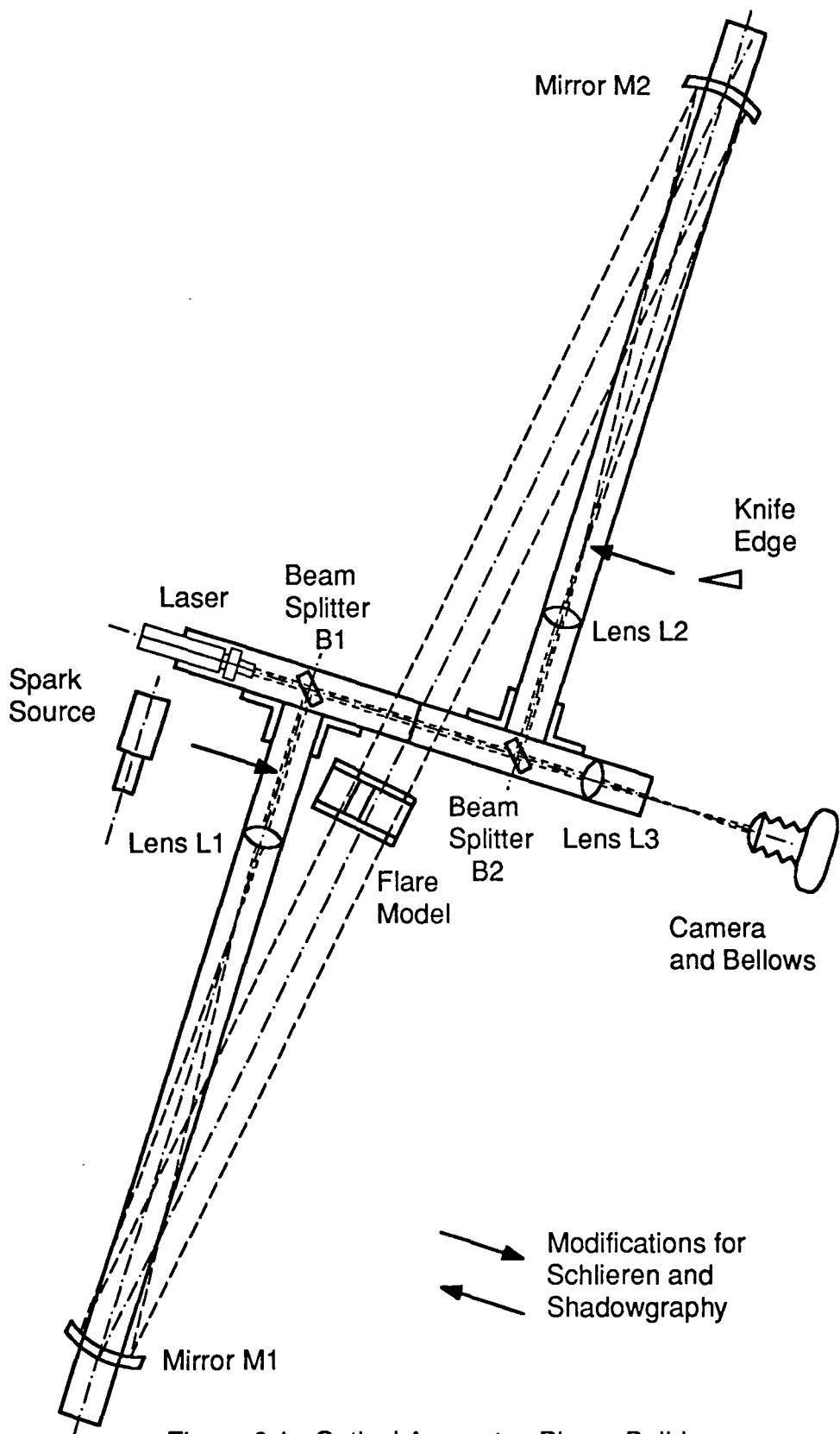


Figure 6.1. Optical Apparatus Planar Build



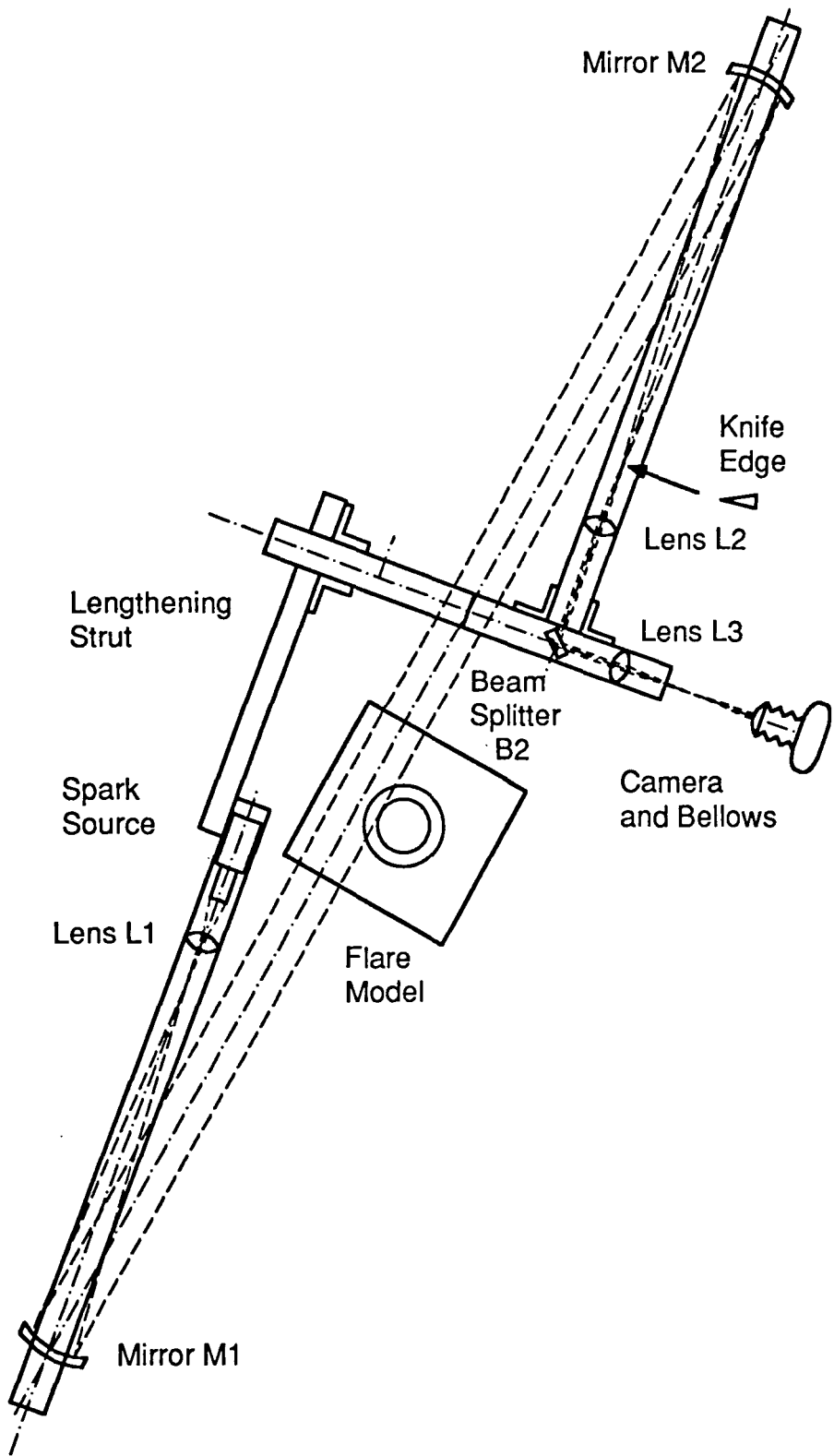


Figure 6.2. Optical Apparatus Axisymmetric Build

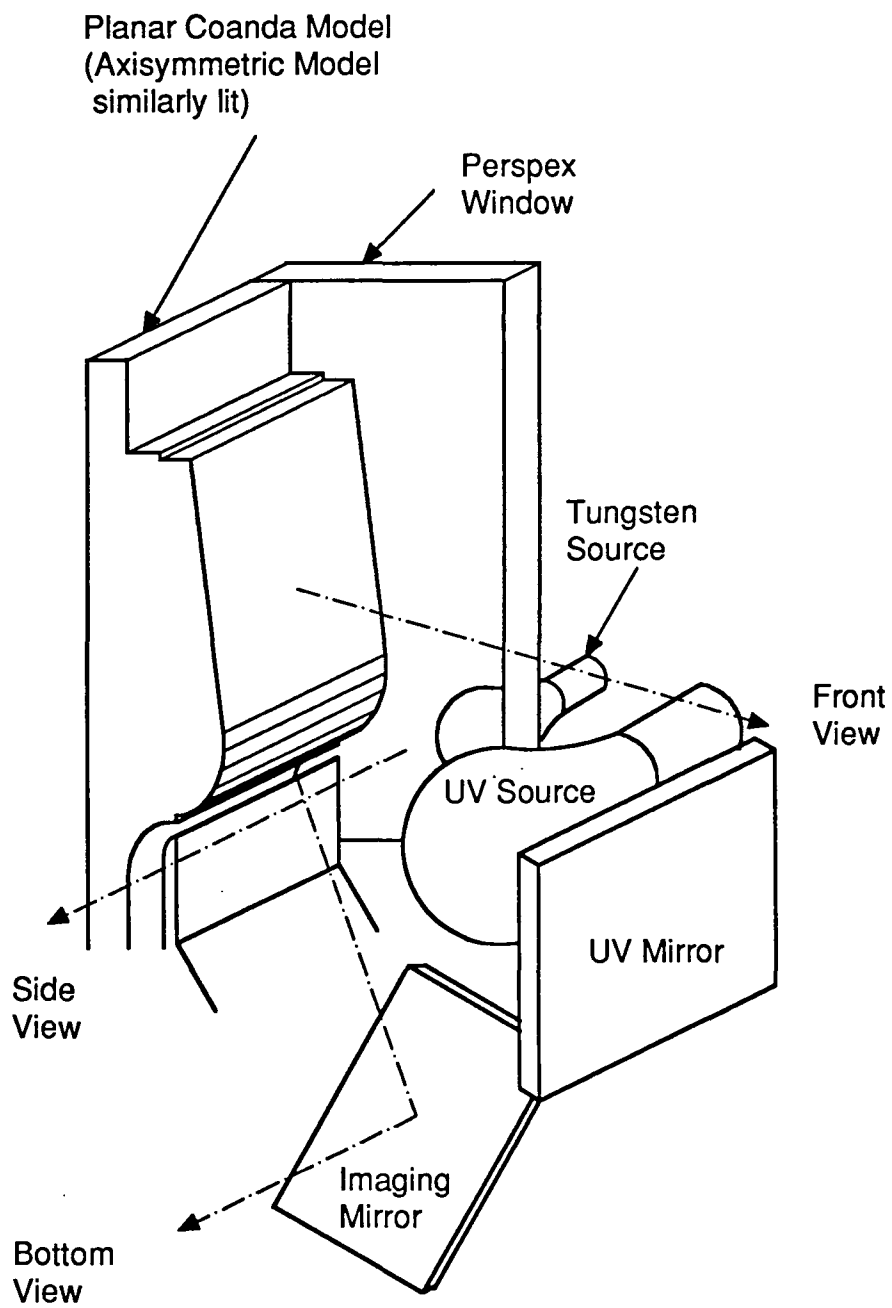


Figure 6.3. Flare Model Surface Flow Visulation  
Photography Layout

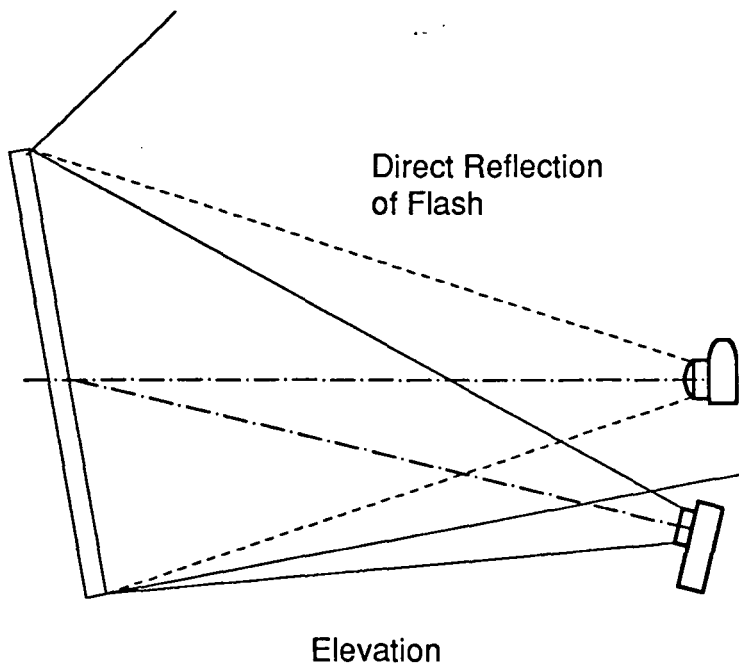
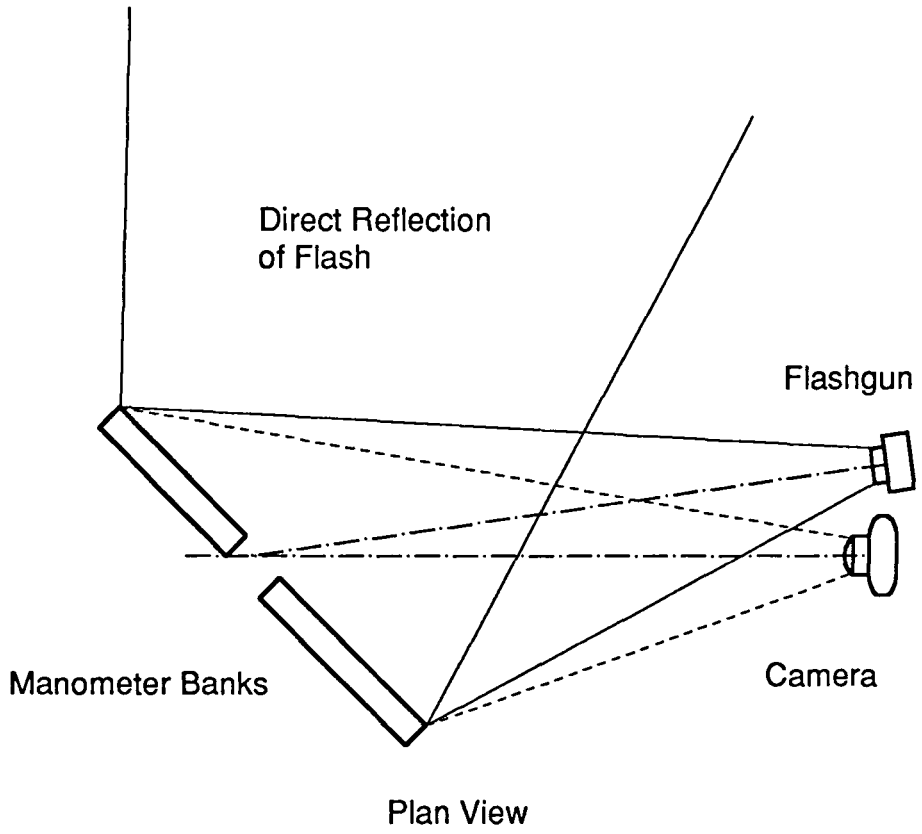


Figure 6.4. Manometer Tube Photography

Pressure Ratio  
[ $P_o/P_{atm}$ ]

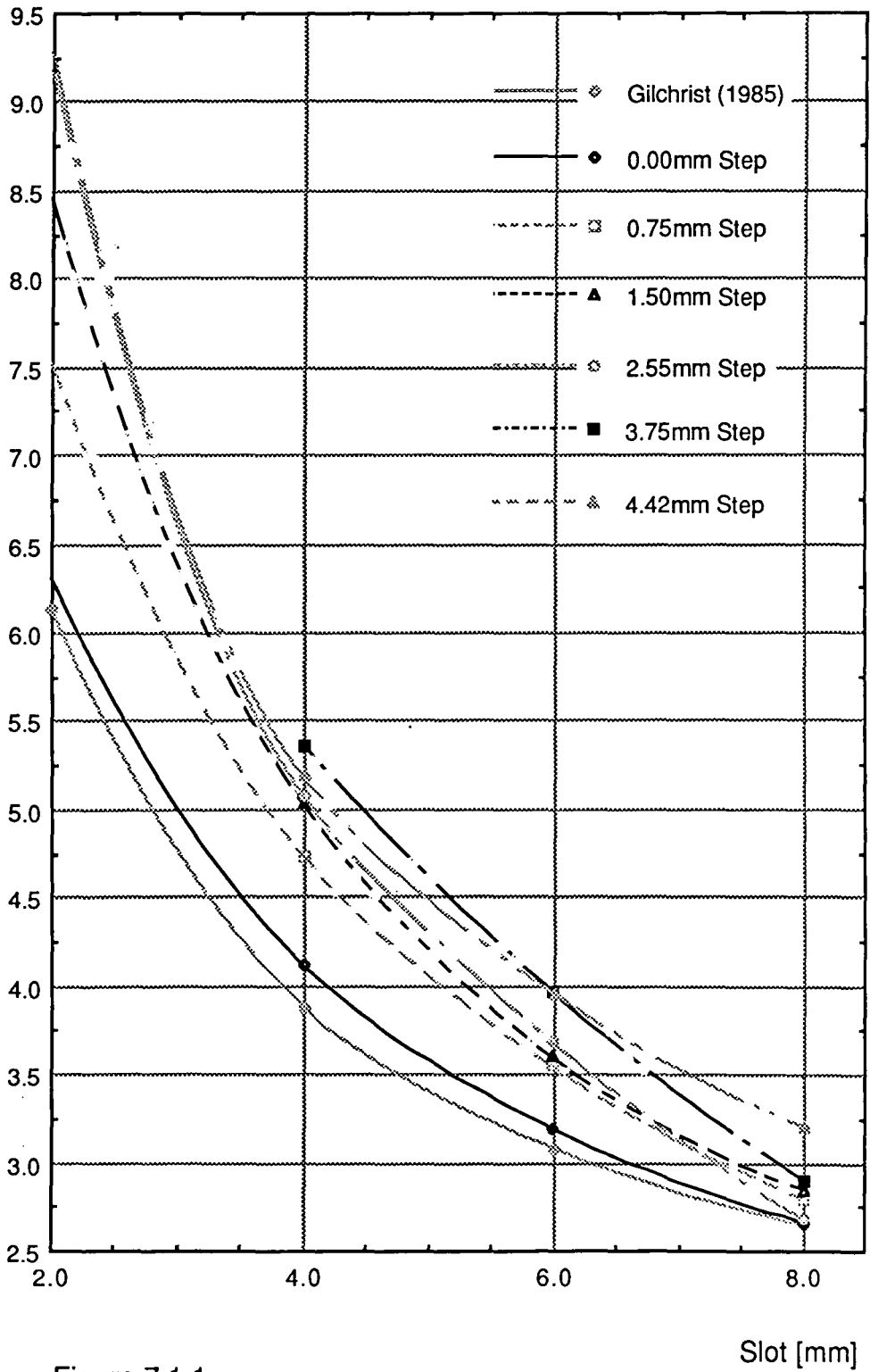


Figure 7.1.1.

Planar Coanda Model  
Breakaway Behaviour

Pressure Ratio  
[ $P_o/P_{atm}$ ]

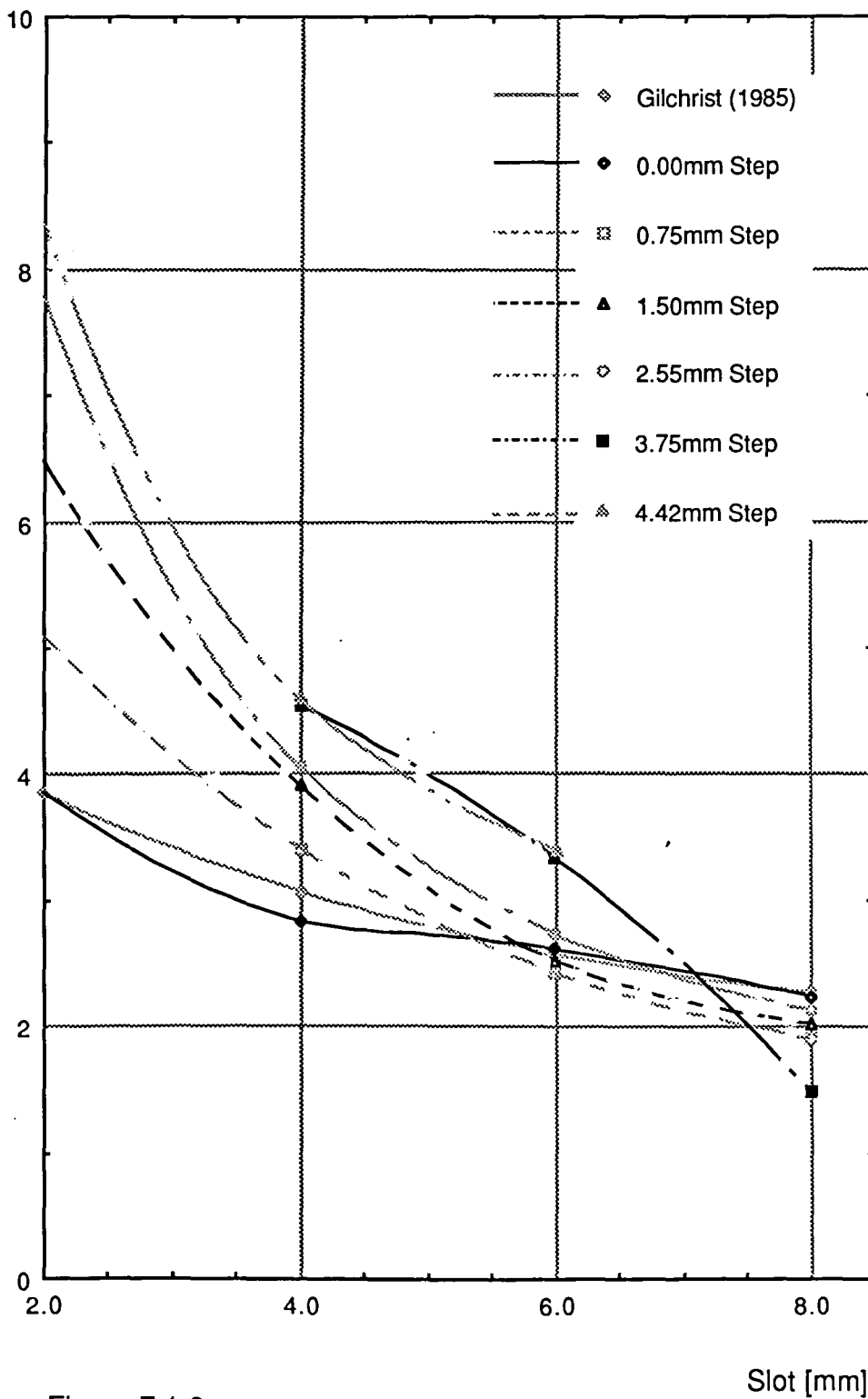


Figure 7.1.2.

Planar Coanda Model  
Reversion Behaviour

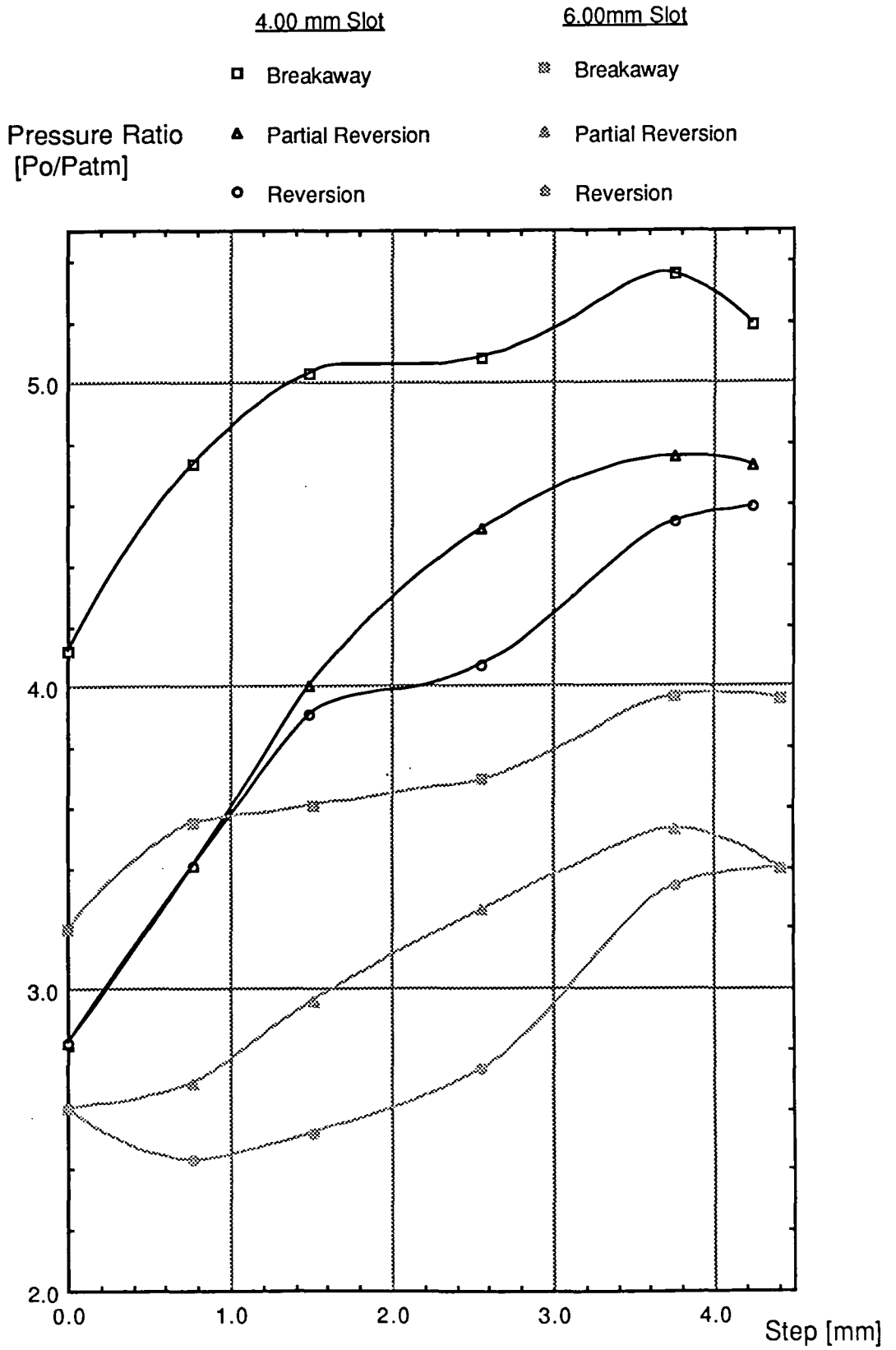


Figure 7.1.3.

Planar Coanda Model  
Partial Reversion Behaviour

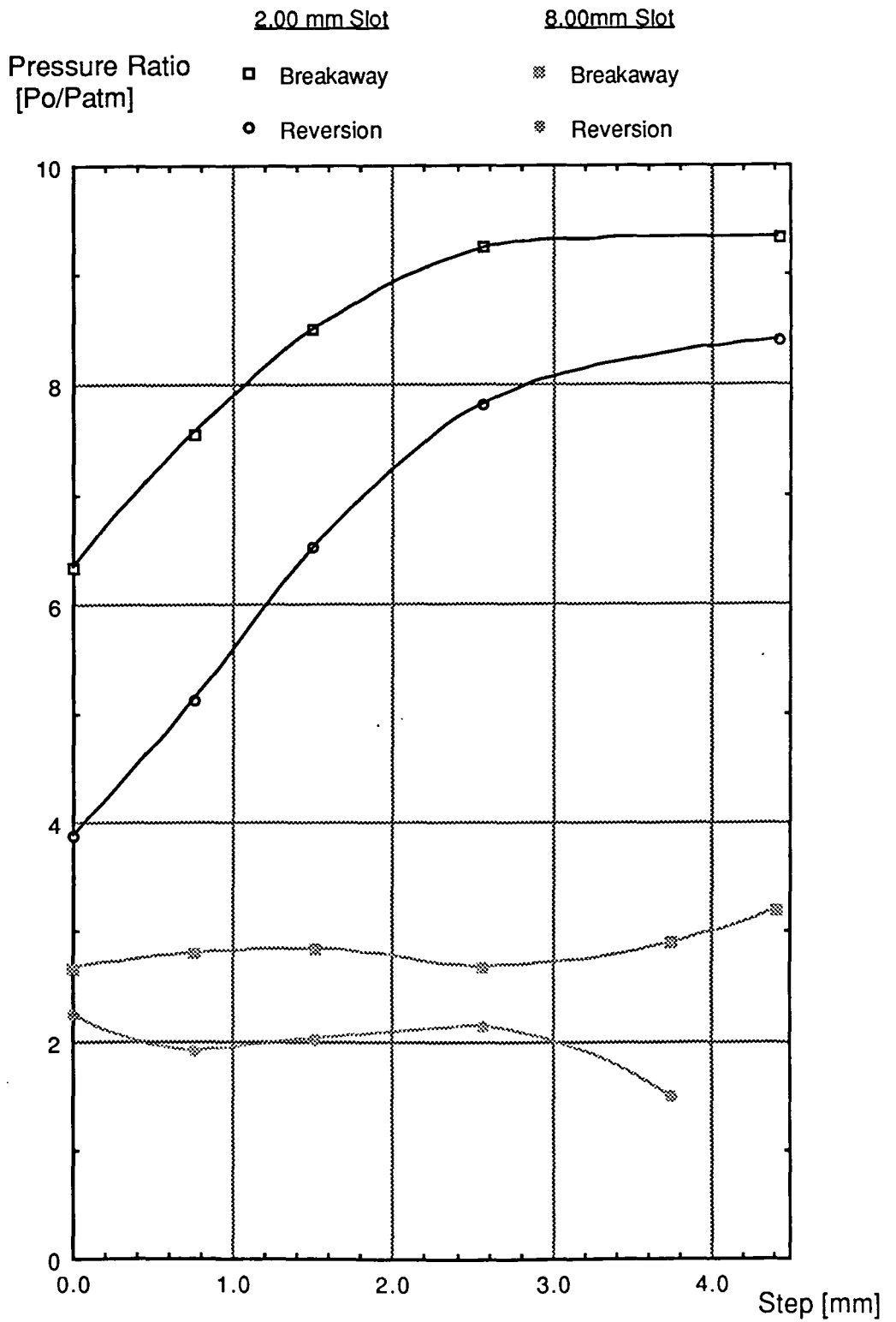


Figure 7.1.4.

Planar Coanda Model  
Breakaway/Reversion Behaviour

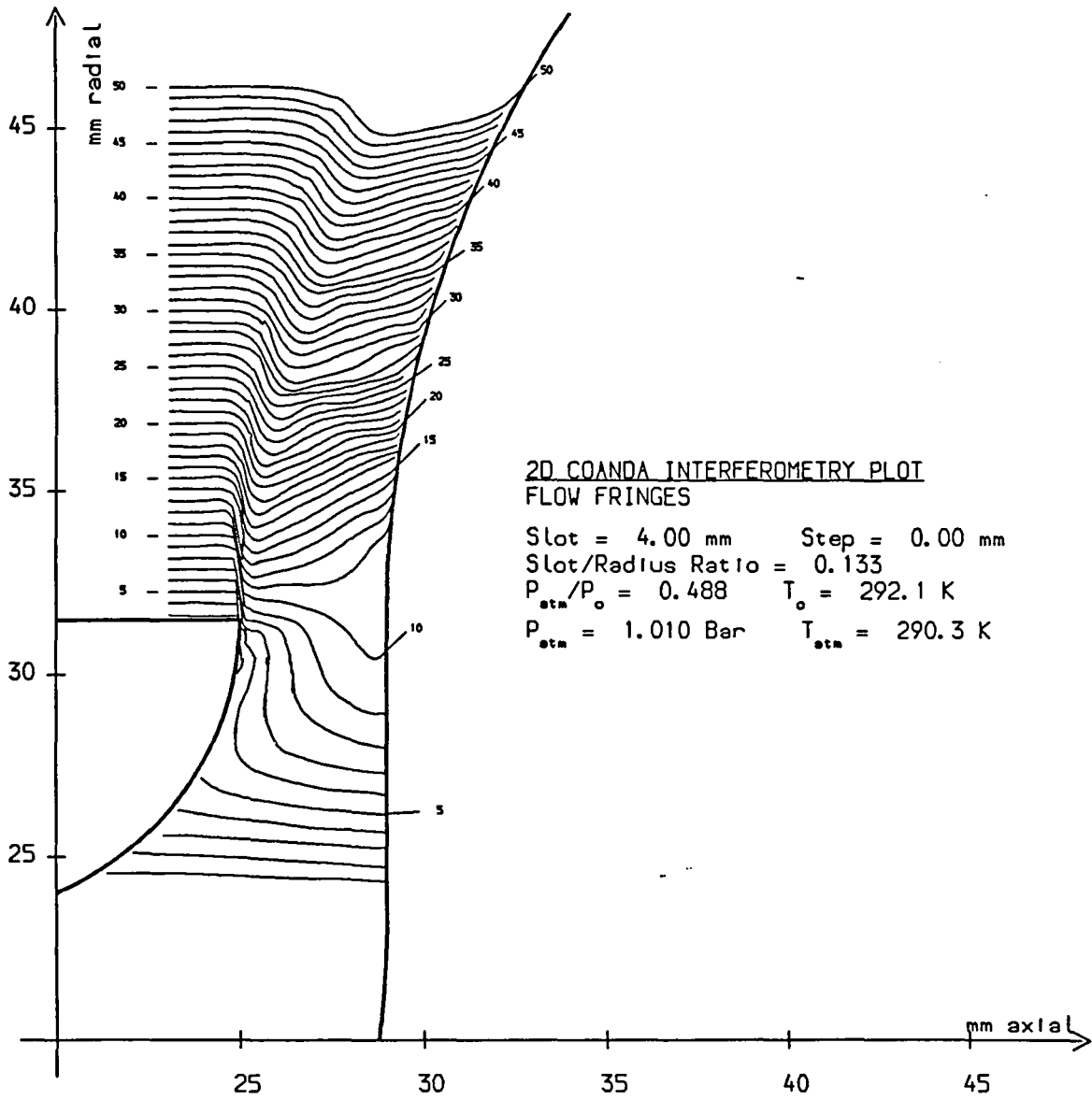


Figure 7.1.5 Interferometry Fringe Pattern --  
Choking Conditions



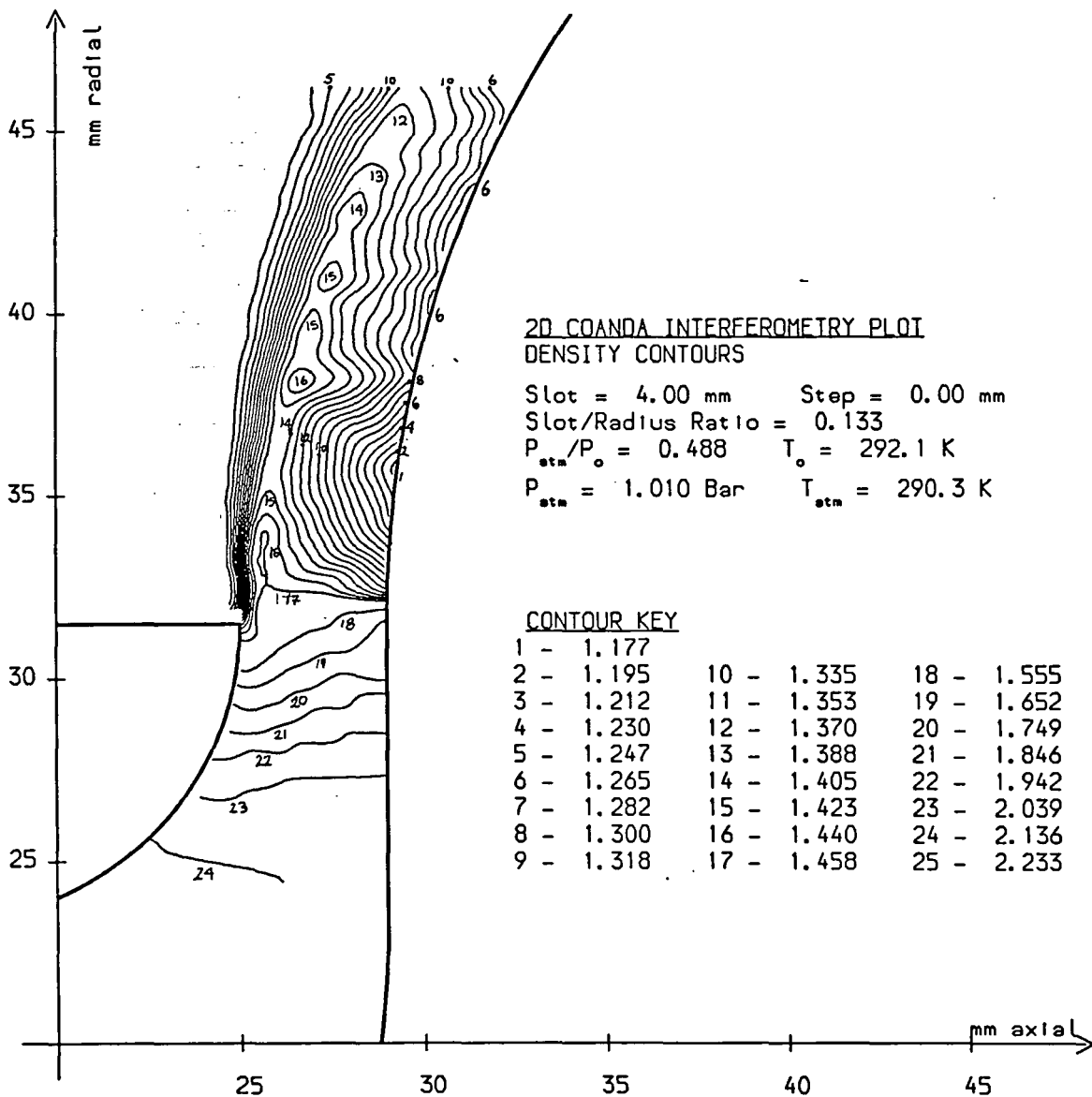
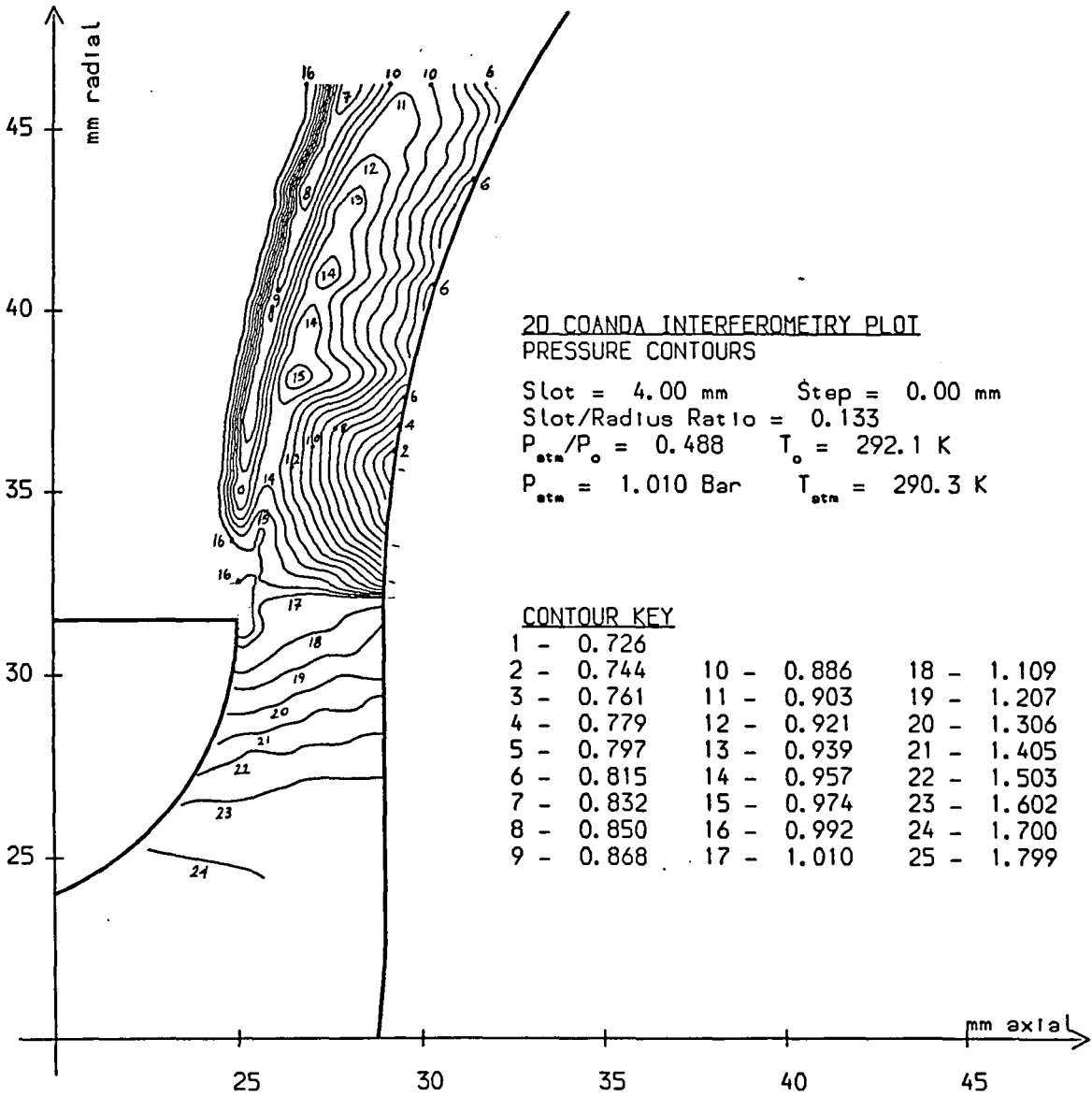
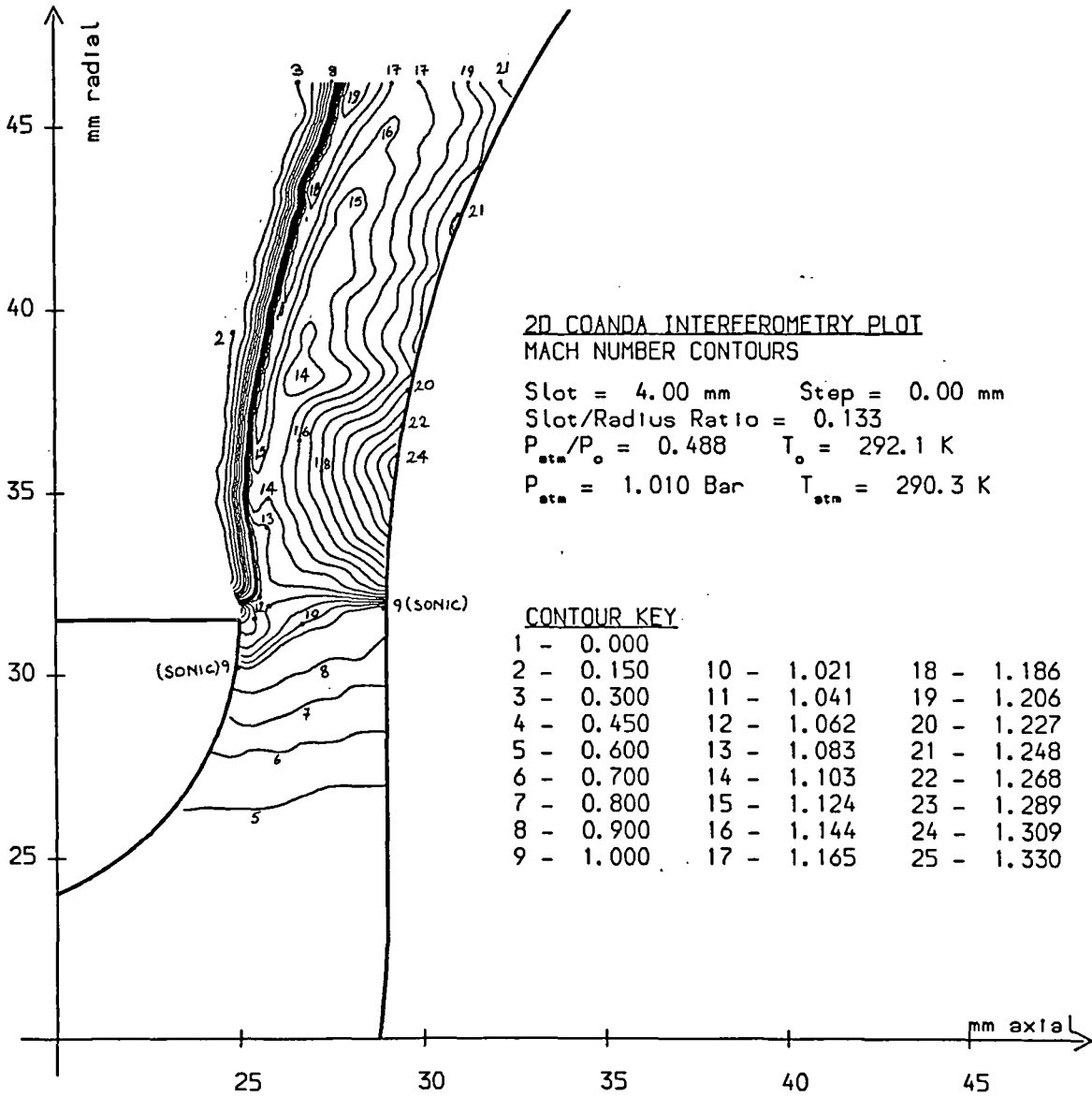


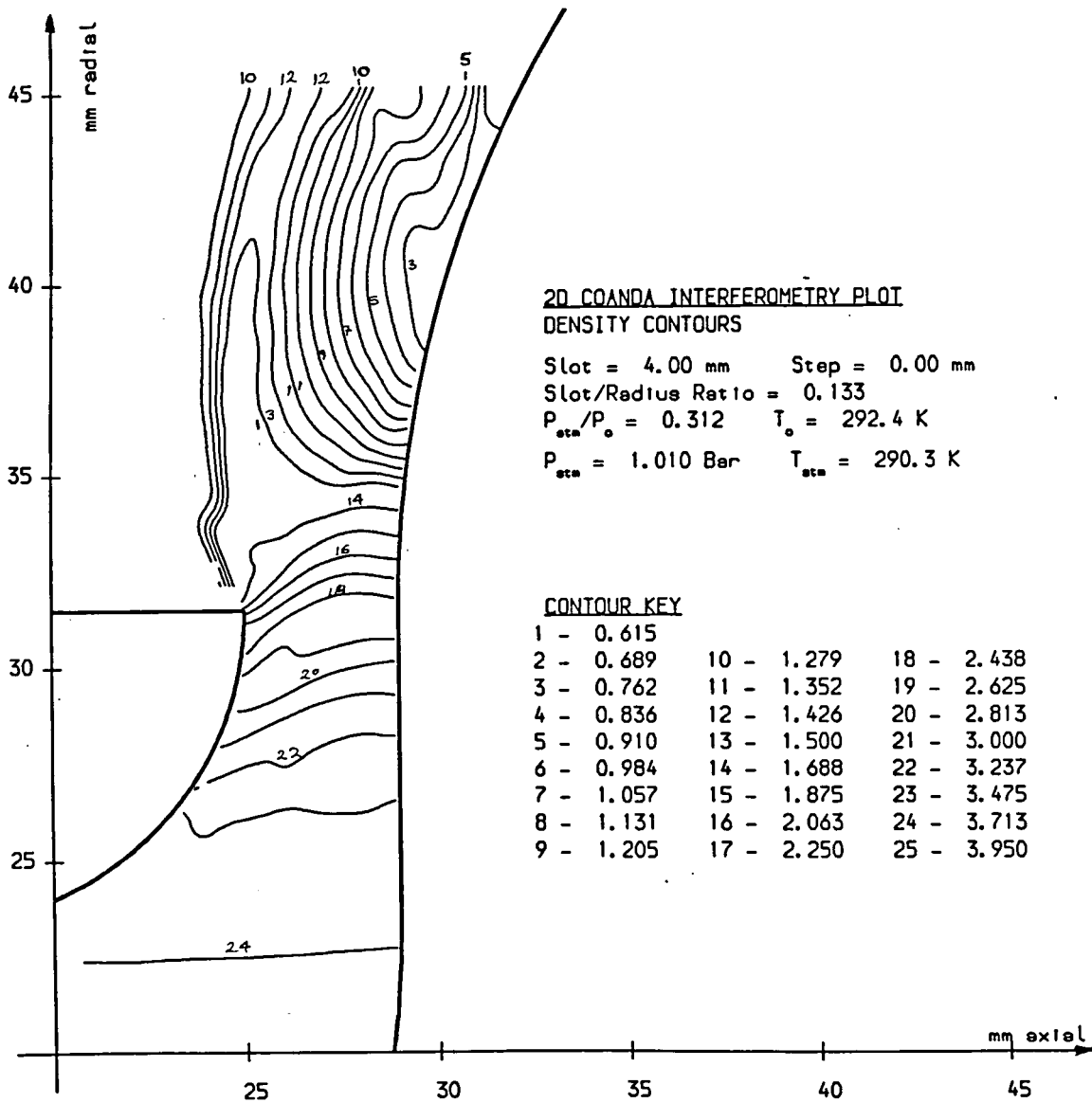
Figure 7.1.6 Interferometry Density Contours --  
Choking Conditions



**Figure 7.1.7 Interferometry Pressure Contours --  
Choking Conditions**



**Figure 7.1.8 Interferometry Mach Number Contours --  
 Choking Conditions**



**Figure 7.1.9 Interferometry Density Contours --  
Underexpanding Conditions**

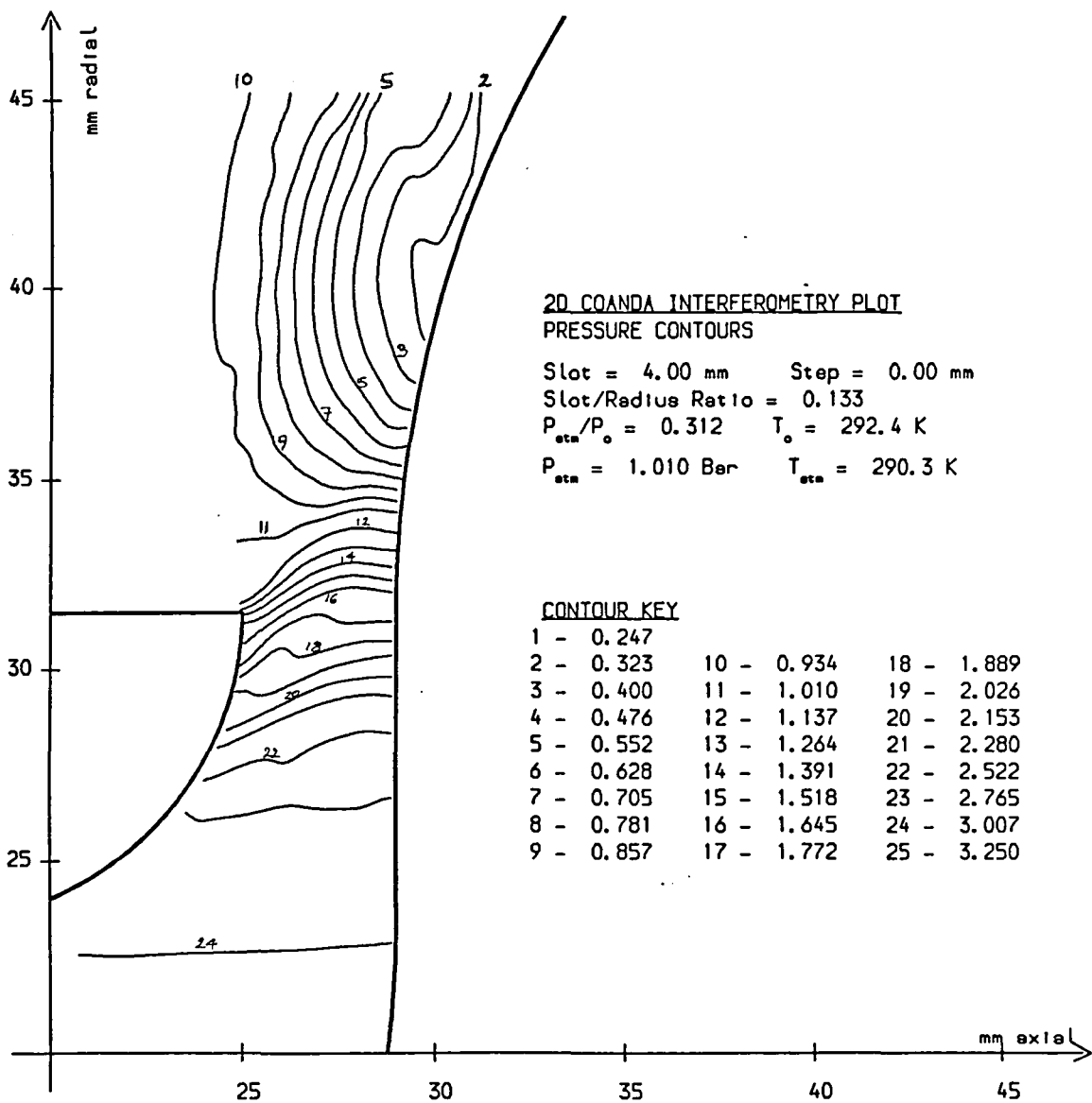


Figure 7.1.10 Interferometry Pressure Contours --  
Underexpanding Conditions

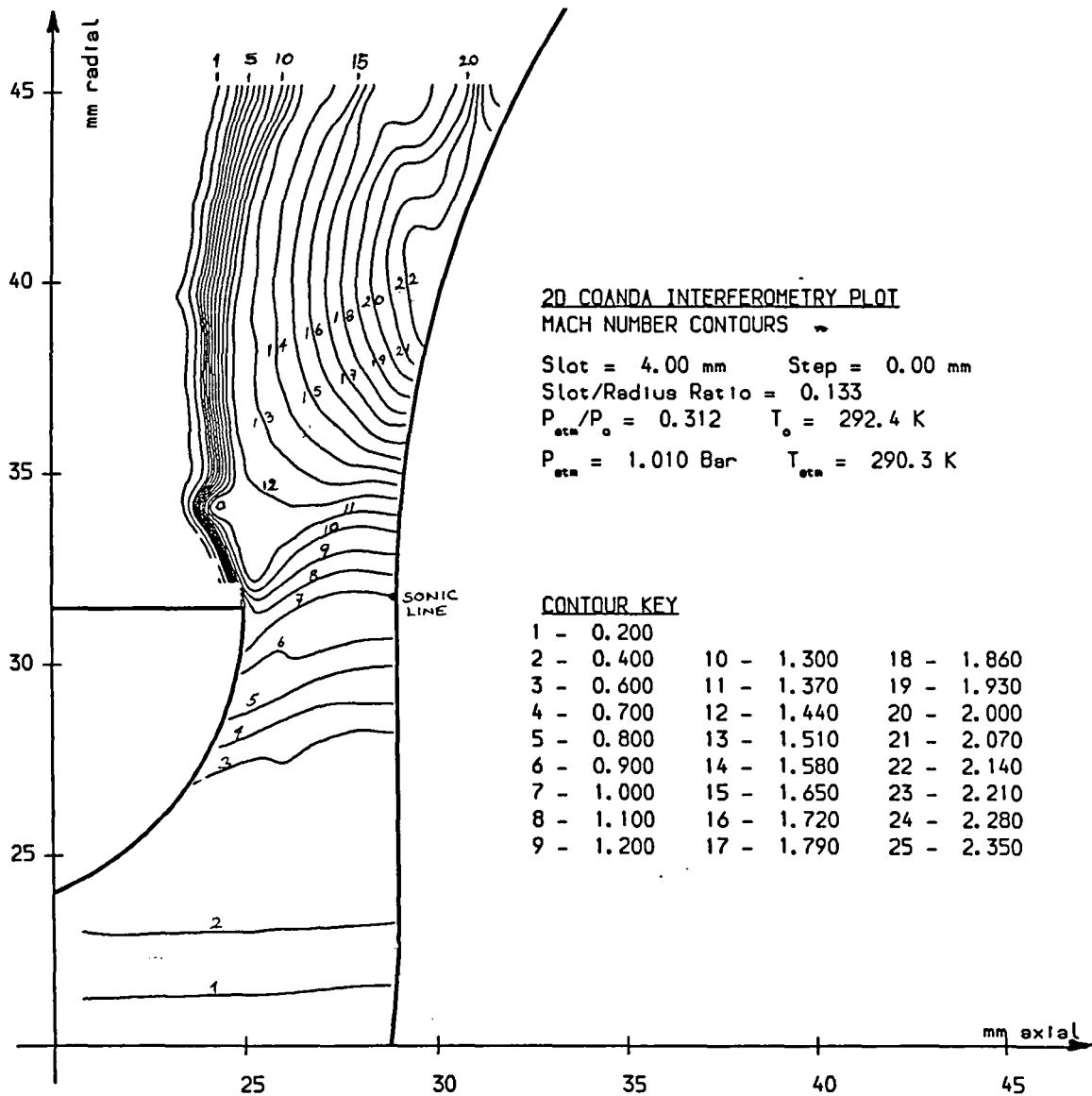


Figure 7.1.11 Interferometry Mach Number Contours -- Underexpanding Conditions

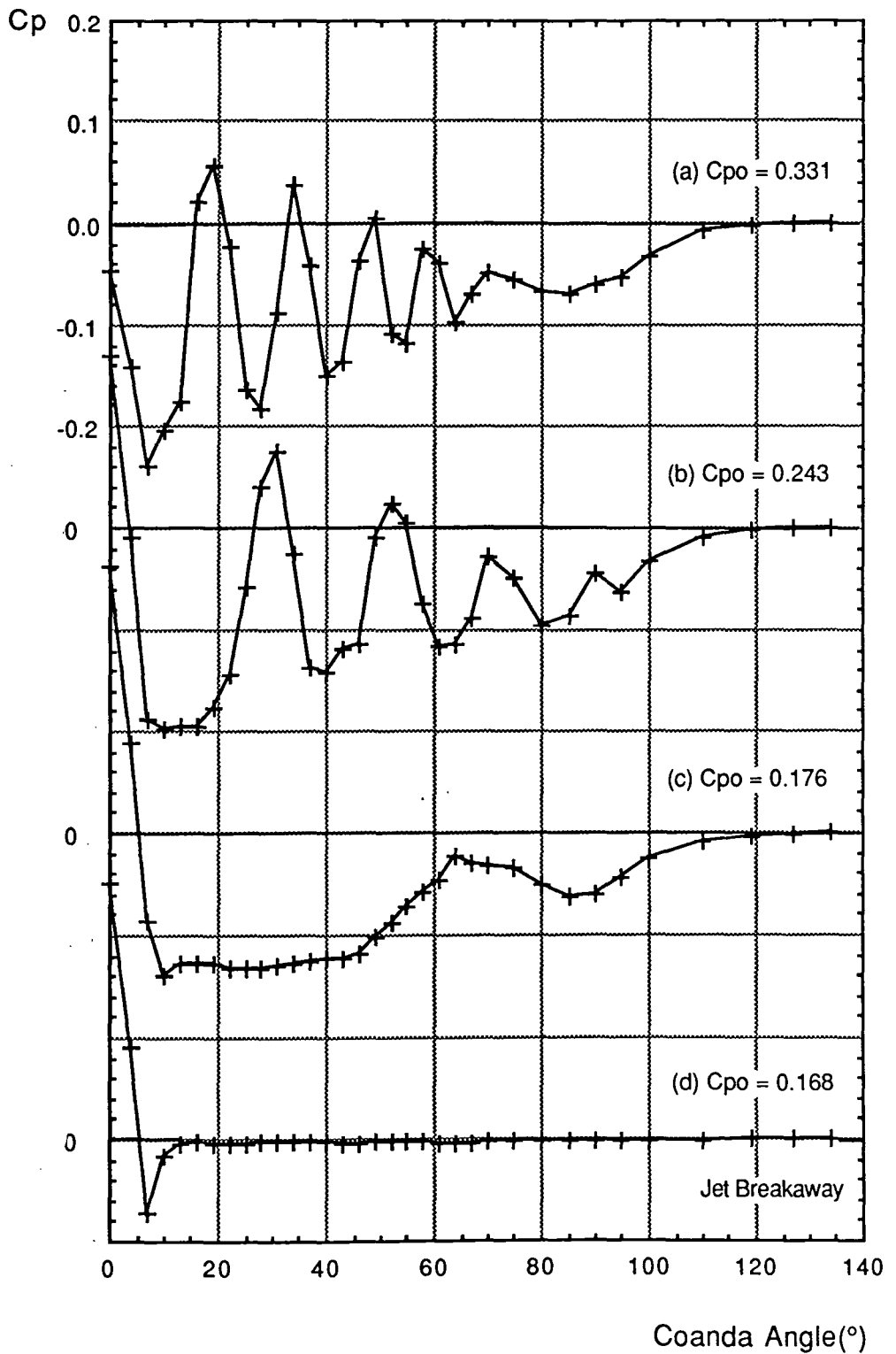


Figure 7.1.12.

Planar Coanda Model  
Experimental Surface Pressures

Slot = 2.00 mm; Step = 0.00 mm

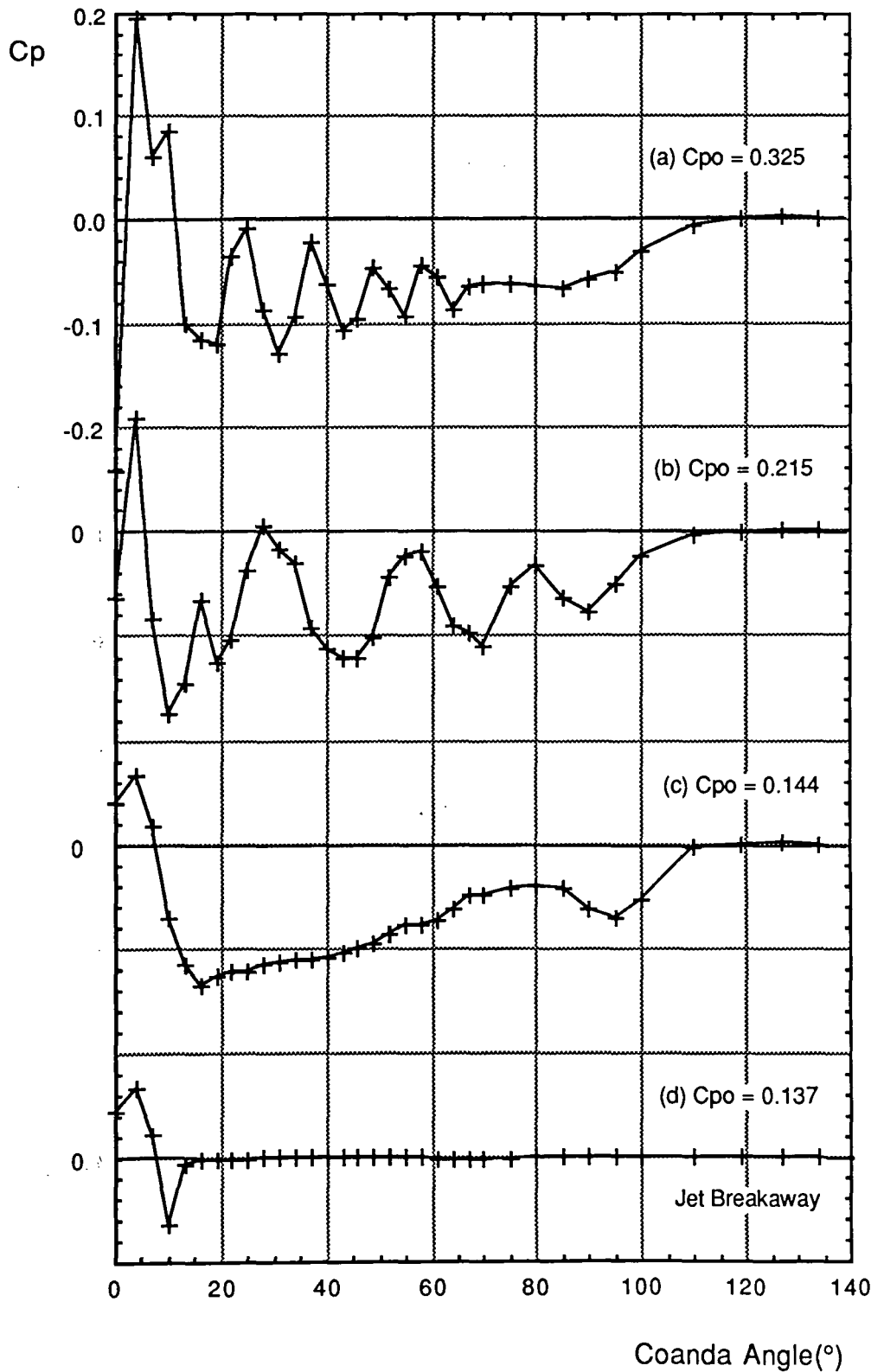


Figure 7.1.13.

Planar Coanda Model

Experimental Surface Pressures

Slot = 2.00 mm; Step = 0.75 mm



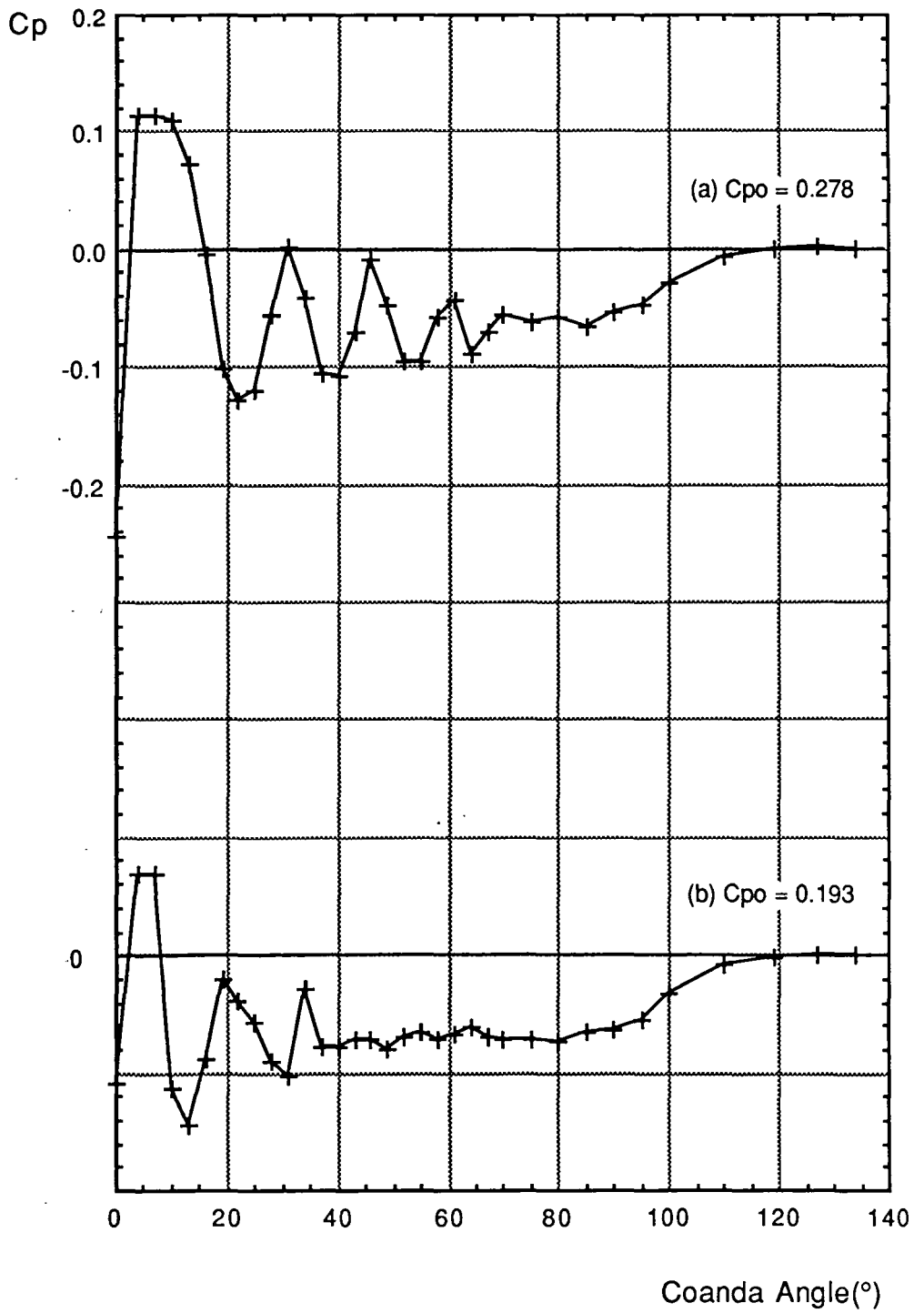


Figure 7. 1.14.

Planar Coanda Model  
Experimental Surface Pressures

Slot = 2.00 mm; Step = 1.50 mm

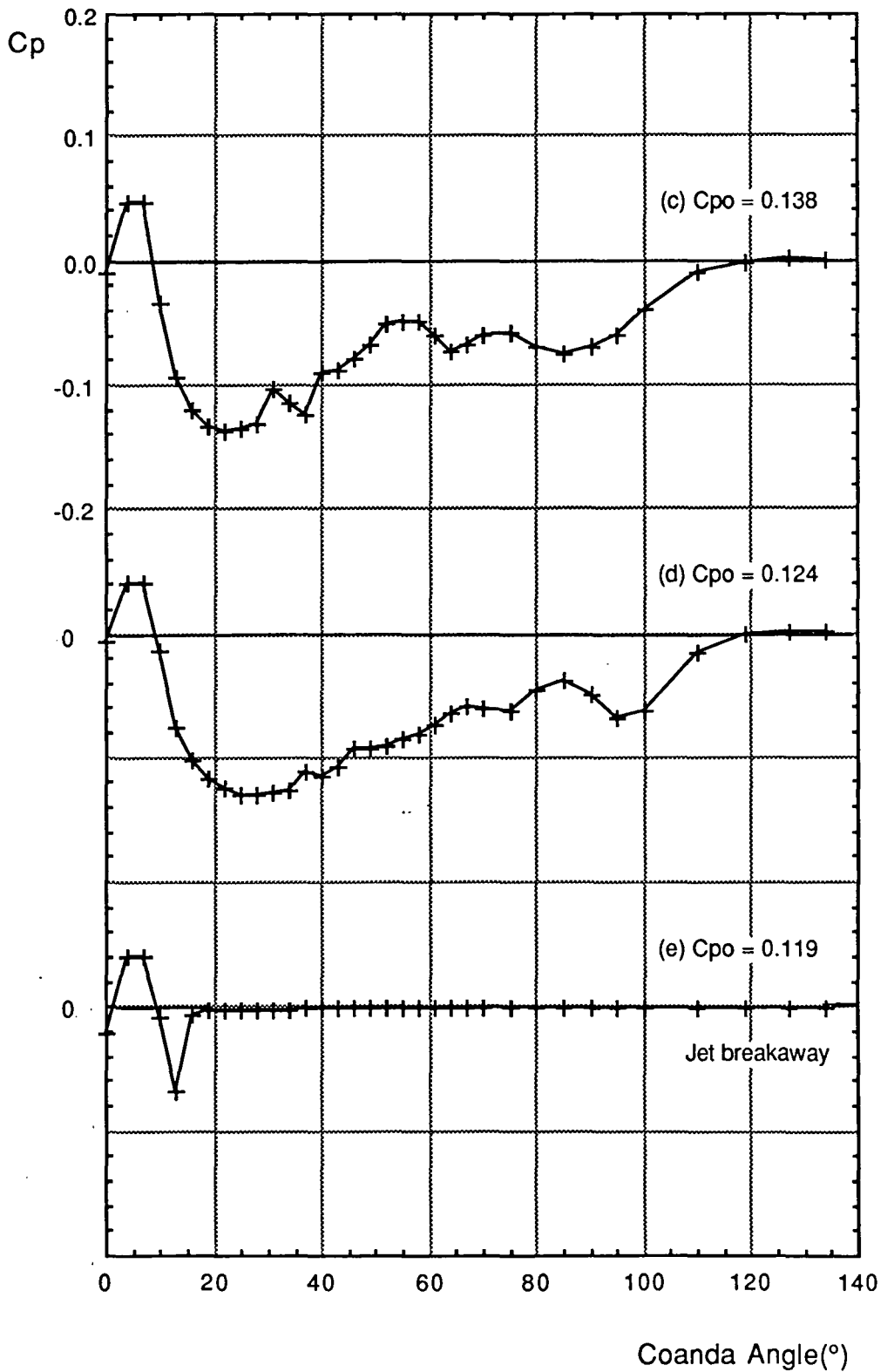


Figure 7. 1.15.

Planar Coanda Model  
 Experimental Surface Pressures

Slot = 2.00 mm; Step = 1.50 mm

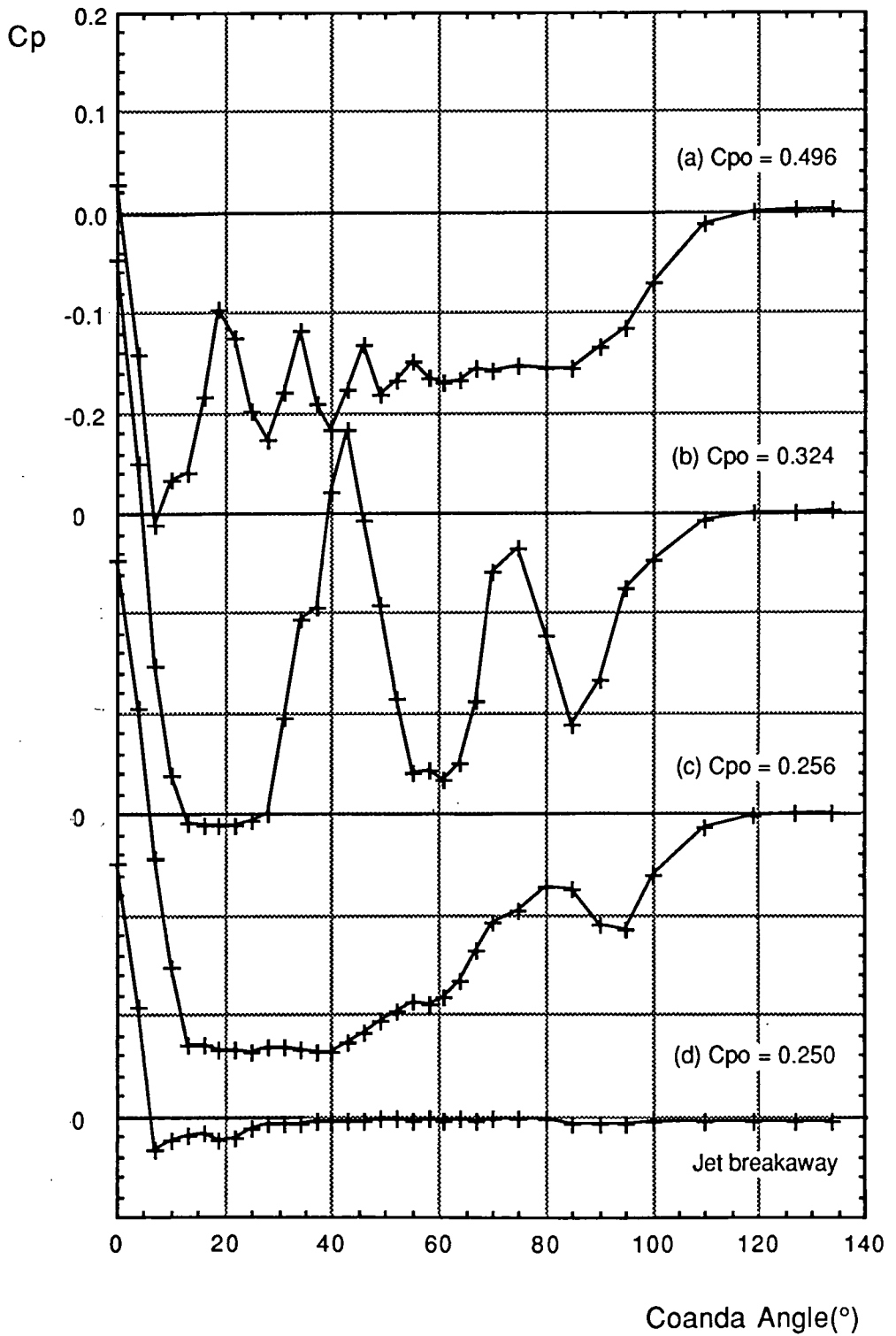


Figure 7. 1.16.

Planar Coanda Model  
 Experimental Surface Pressures

Slot = 4.00 mm; Step = 0.00 mm

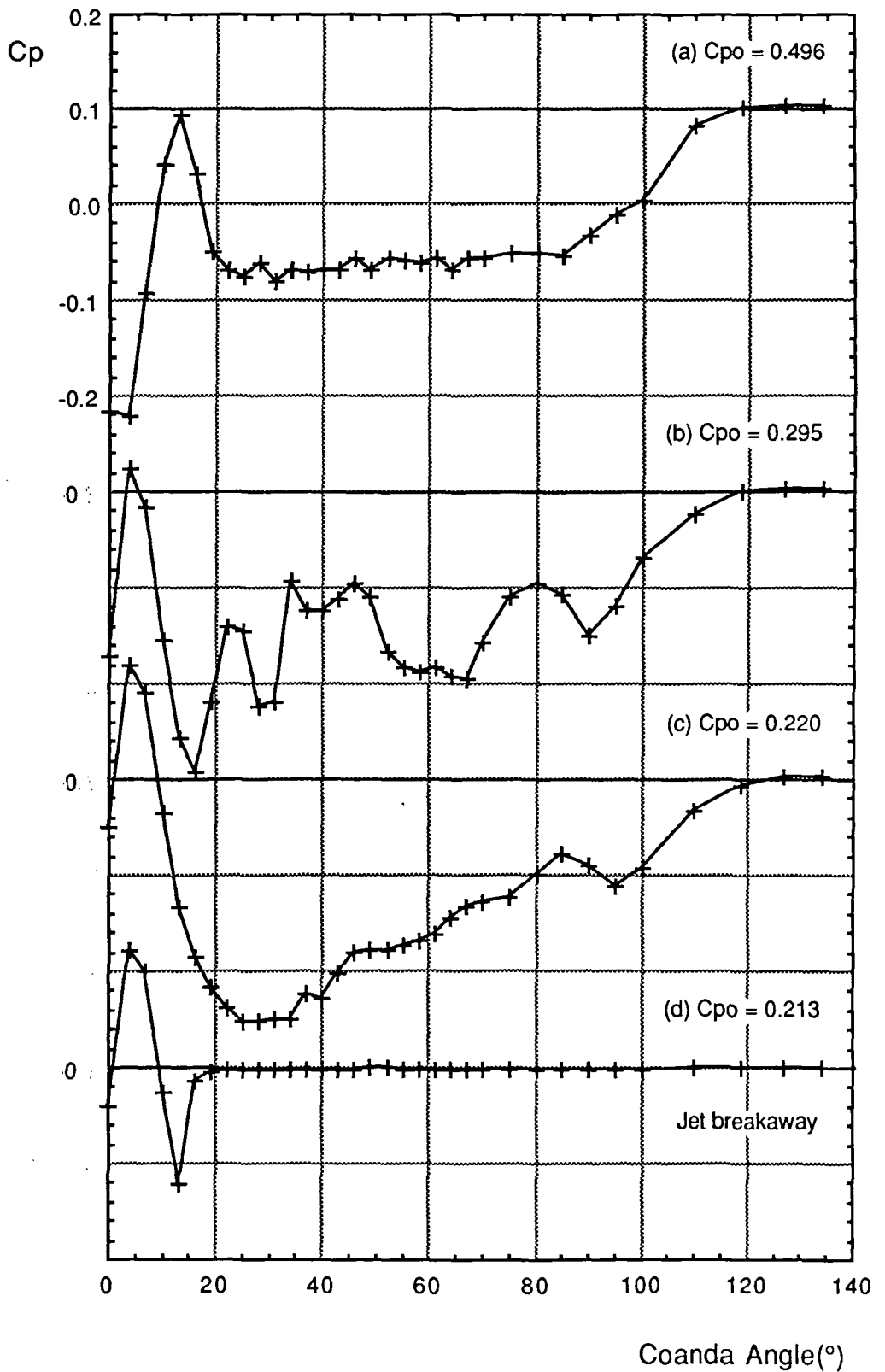


Figure 7.1.17.

Planar Coanda Model  
Experimental Surface Pressures  
 Slot = 4.00 mm; Step = 0.75 mm

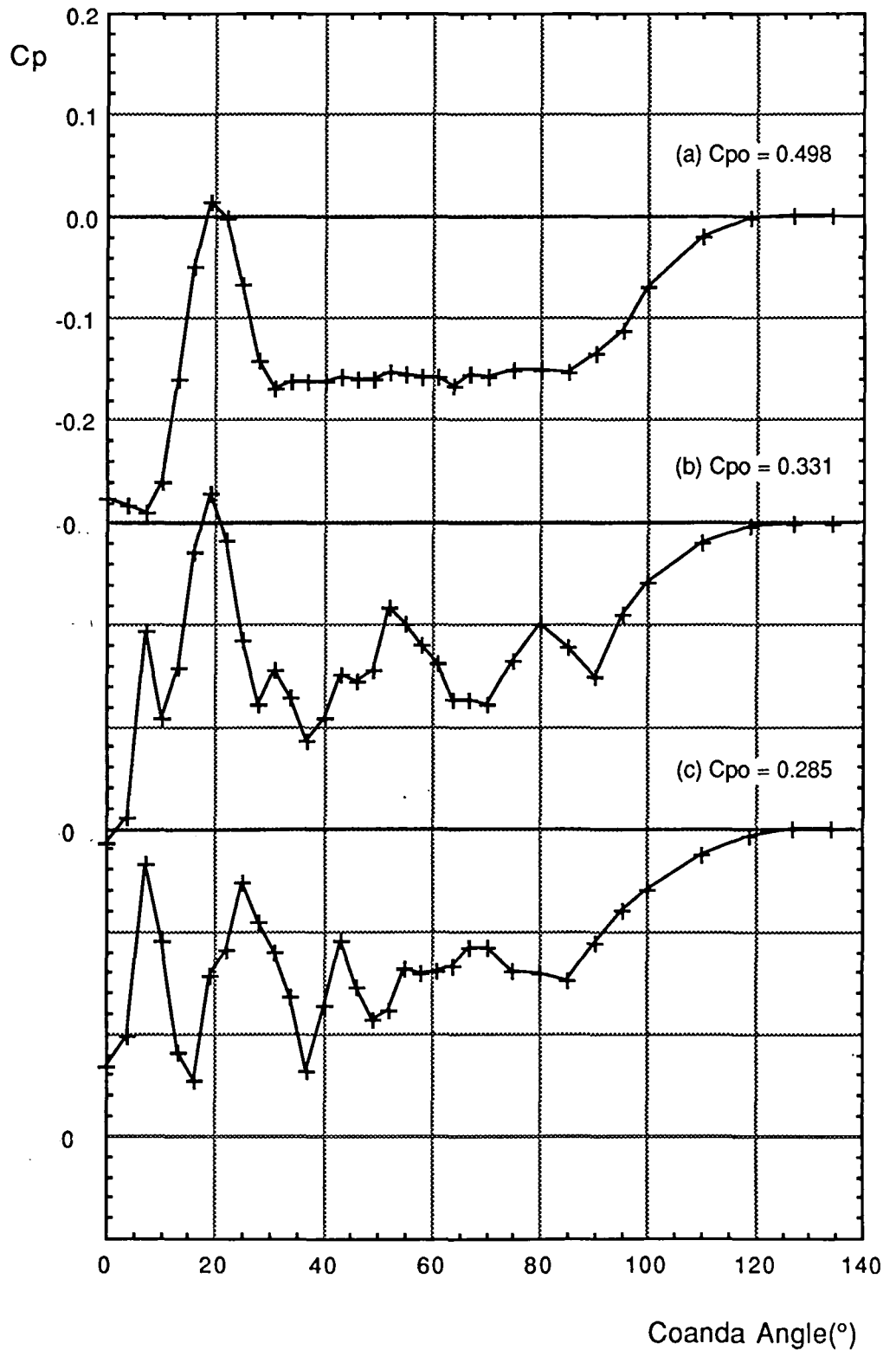


Figure 7.1.18.

Planar Coanda Model

Experimental Surface Pressures

Slot = 4.00 mm; Step = 1.50 mm

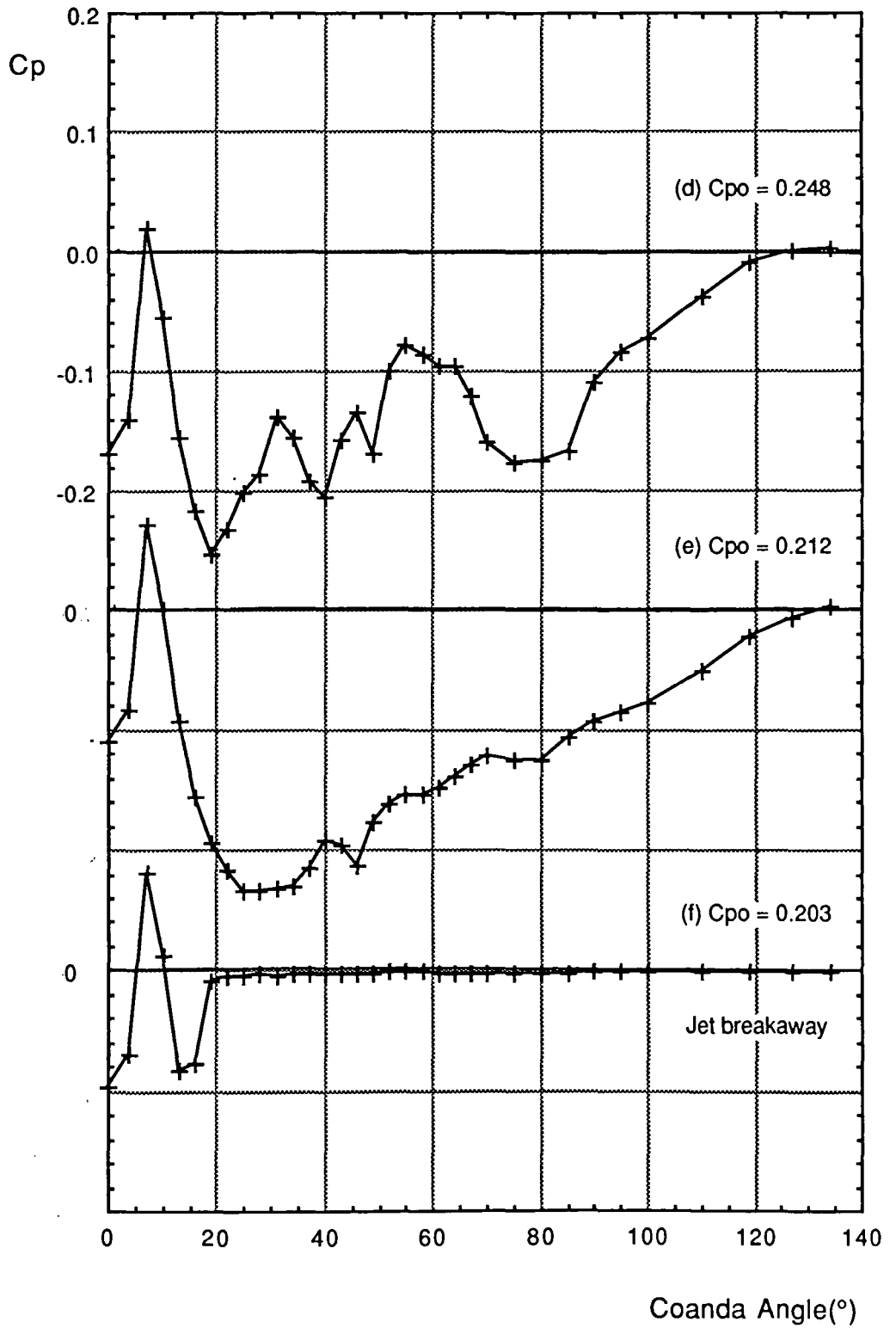


Figure 7.1.19.

Planar Coanda Model  
Experimental Surface Pressures  
 Slot = 4.00 mm; Step = 1.50 mm

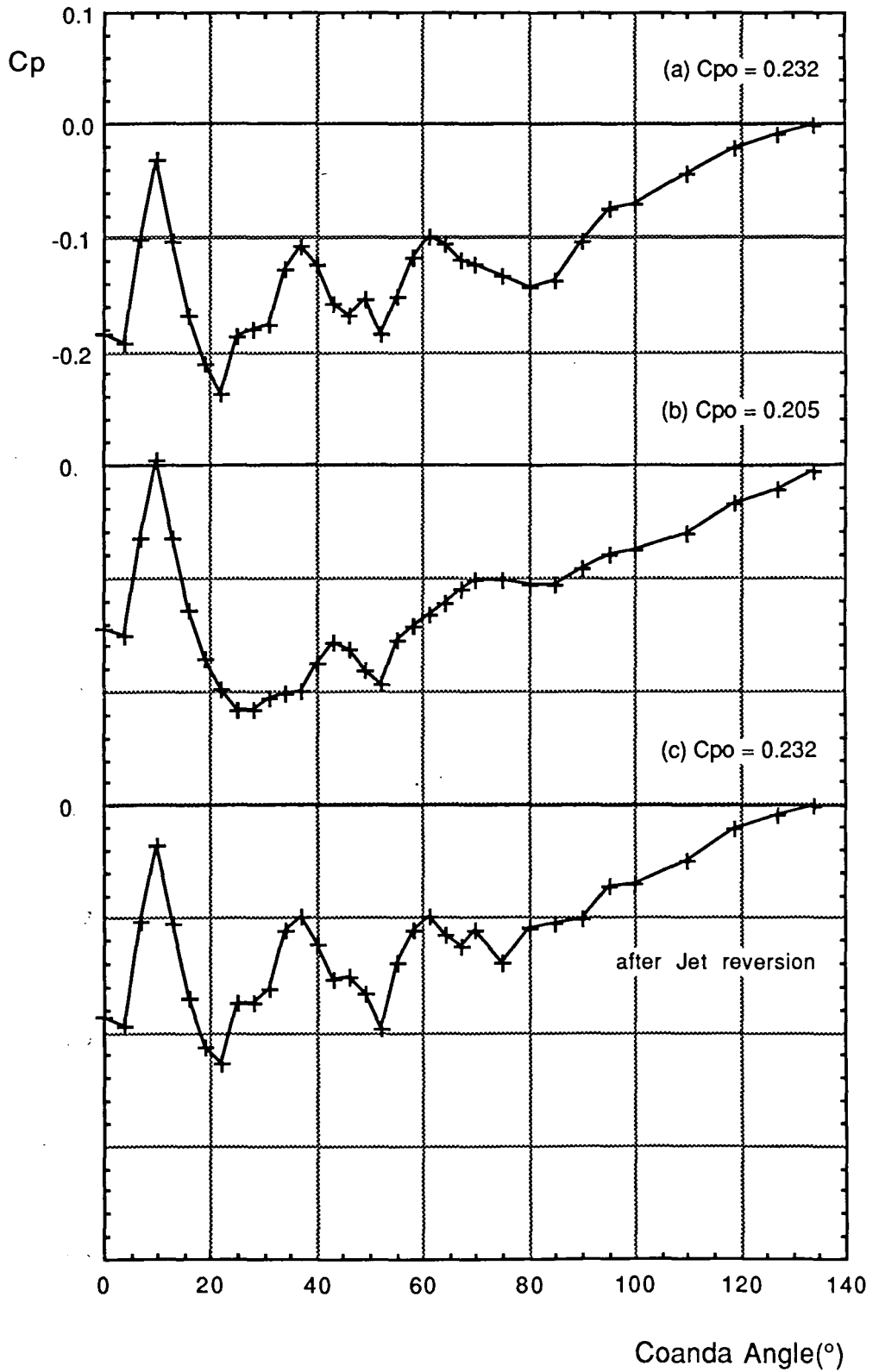


Figure 7.1.20.

Planar Coanda Model  
 Experimental Surface Pressures

Slot = 4.00 mm; Step = 2.55 mm

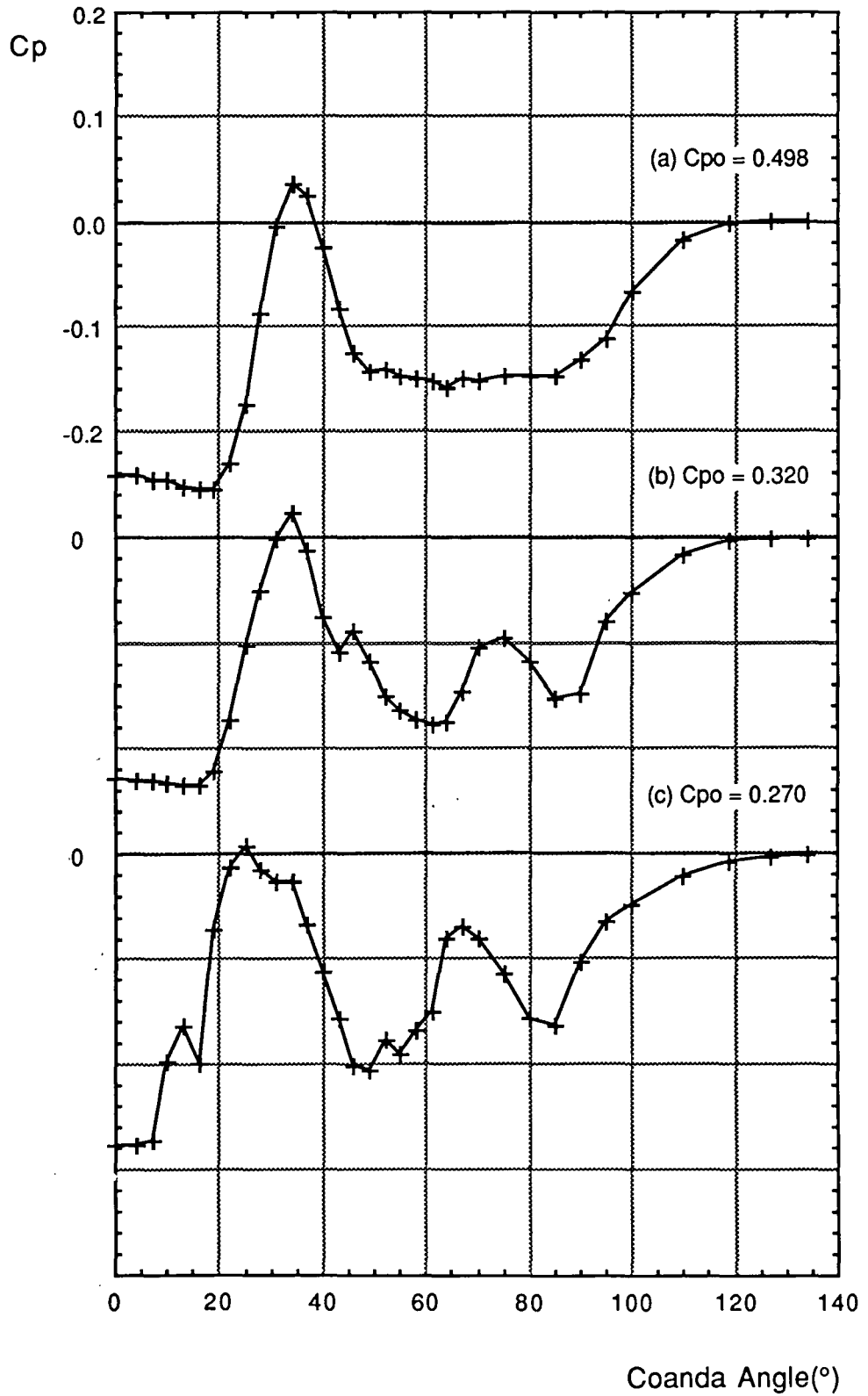


Figure 7.1.21.

Planar Coanda Model  
Experimental Surface Pressures  
 Slot = 4.00 mm; Step = 3.76 mm



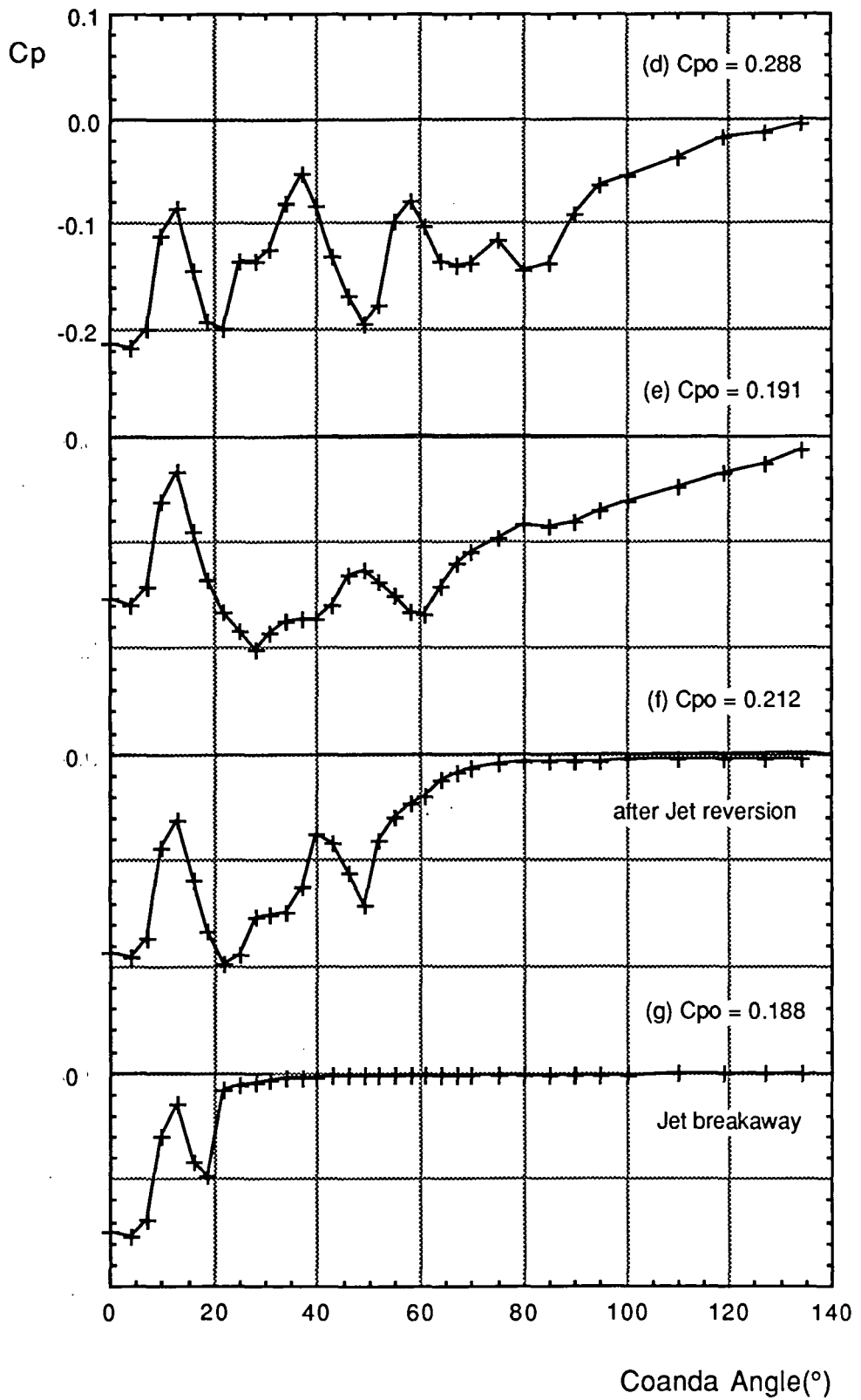


Figure 7.1.22.

Planar Coanda Model  
 Experimental Surface Pressures

Slot = 4.00 mm; Step = 3.76 mm

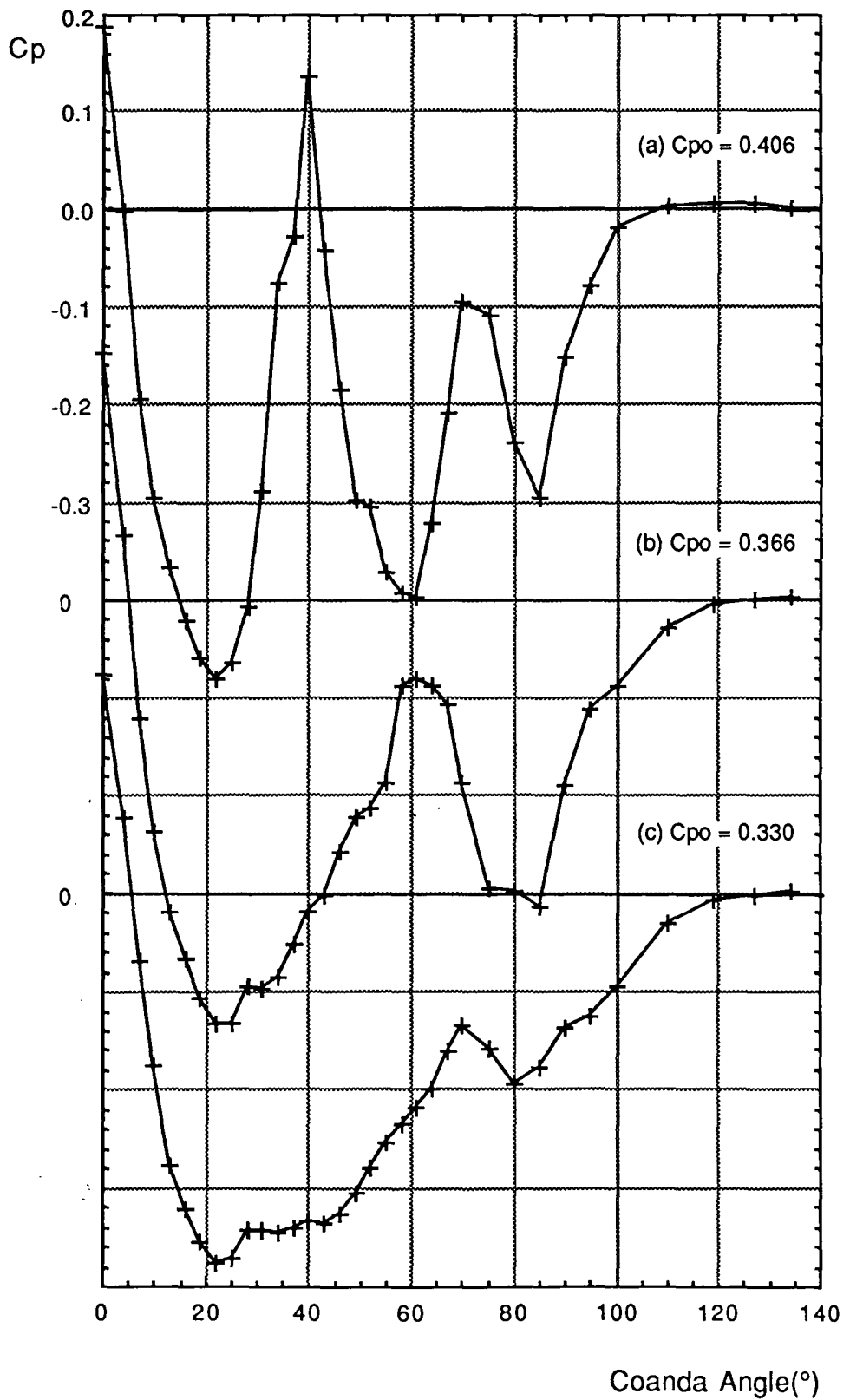


Figure 7.1.23.

Planar Coanda Model  
 Experimental Surface Pressures  
 Slot = 6.00 mm; Step = 0.00 mm

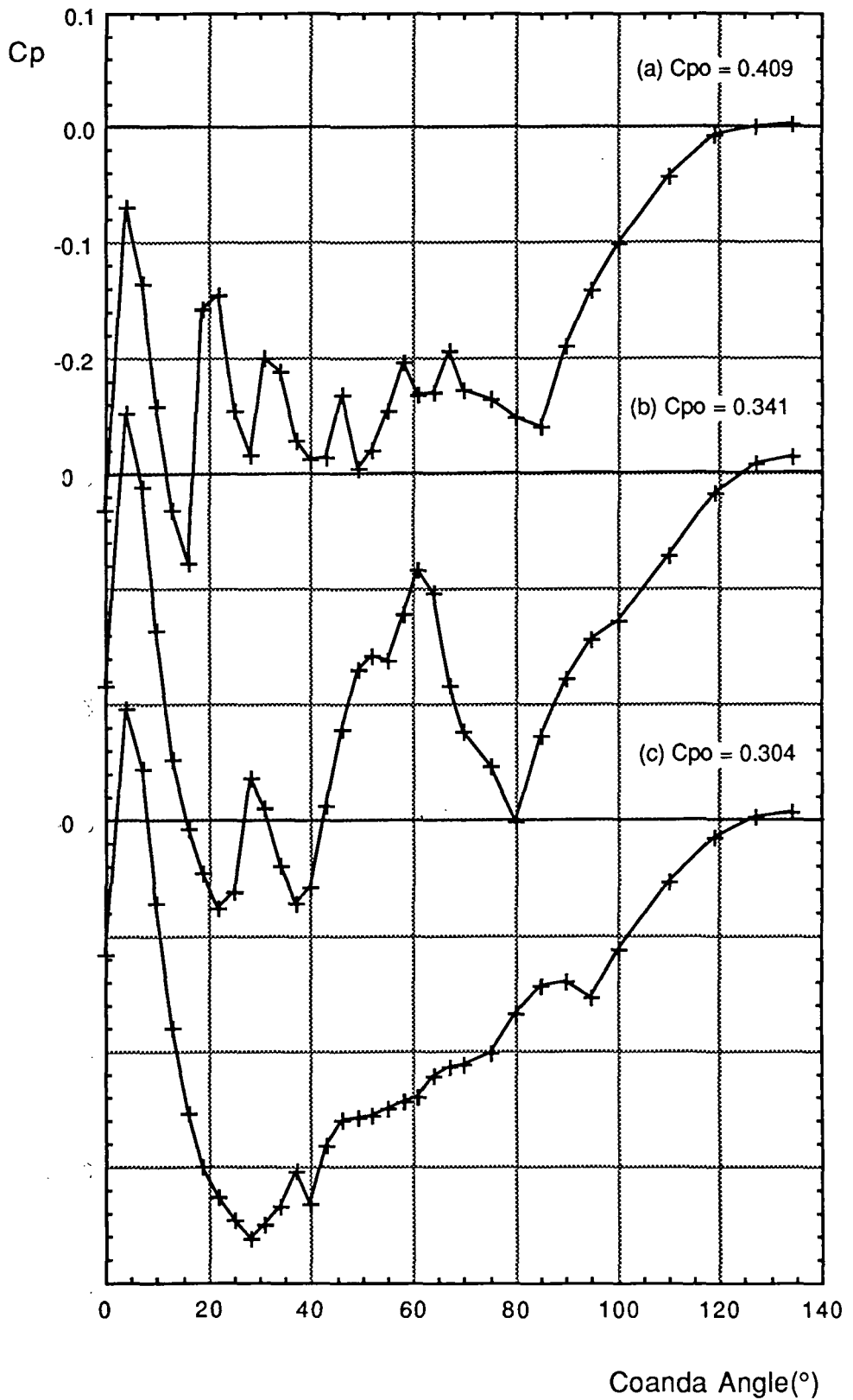


Figure 7.1.24.

Planar Coanda Model  
Experimental Surface Pressures

Slot = 6.00 mm; Step = 0.75 mm

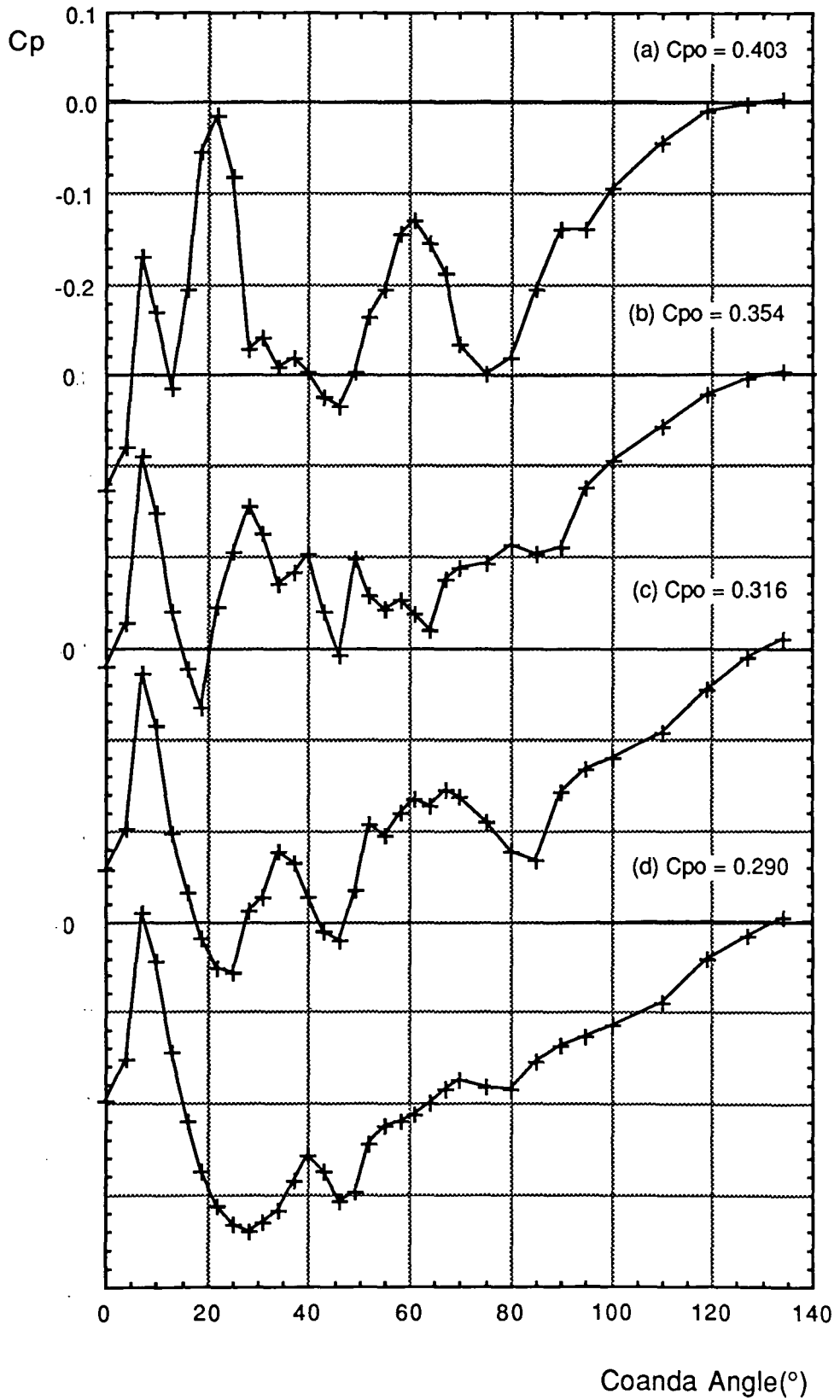


Figure 7.1.25.

Planar Coanda Model  
Experimental Surface Pressures

Slot = 6.00 mm; Step = 1.50 mm

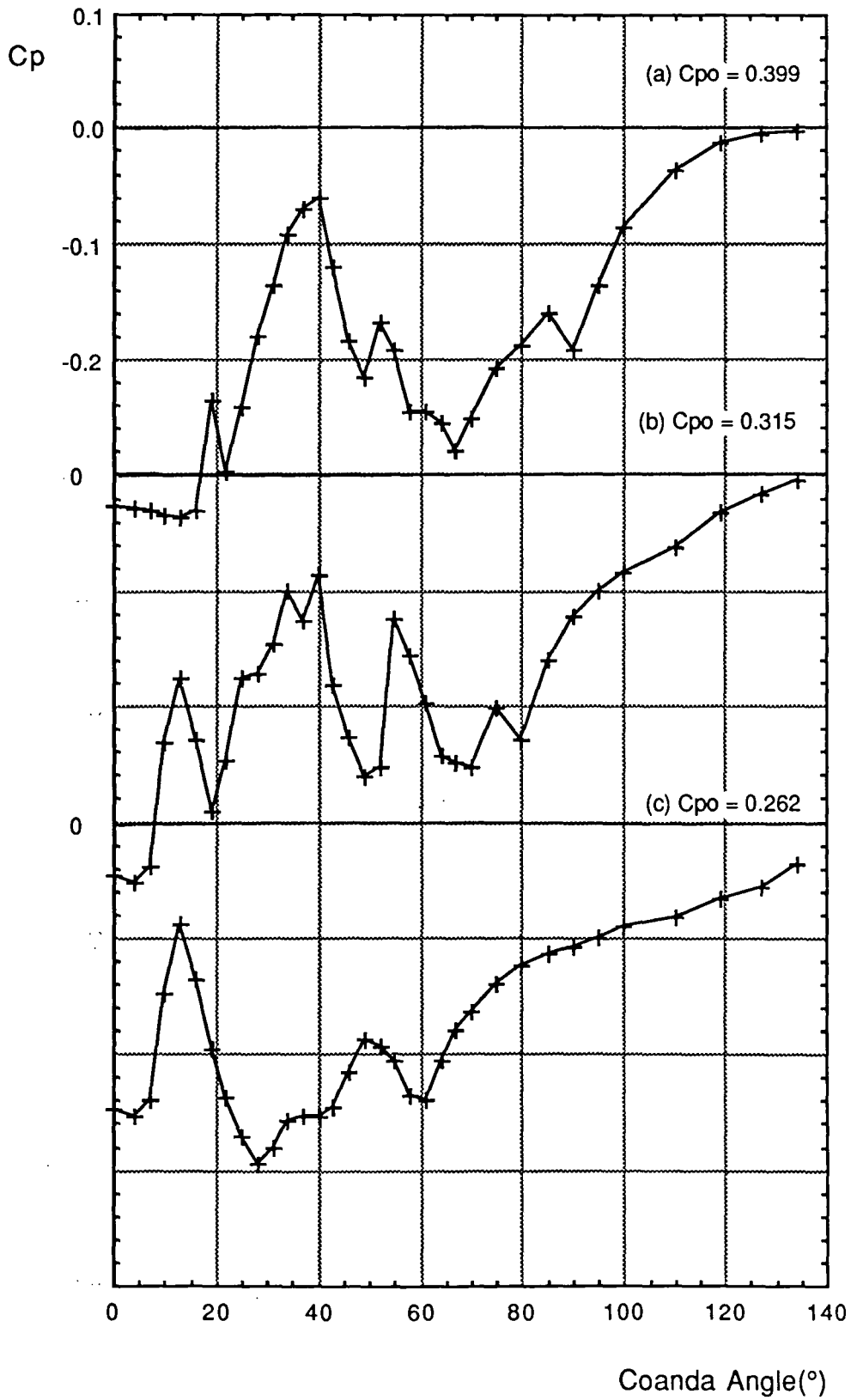


Figure 7.1.26.

Planar Coanda Model  
Experimental Surface Pressures

Slot = 6.00 mm; Step = 3.75 mm

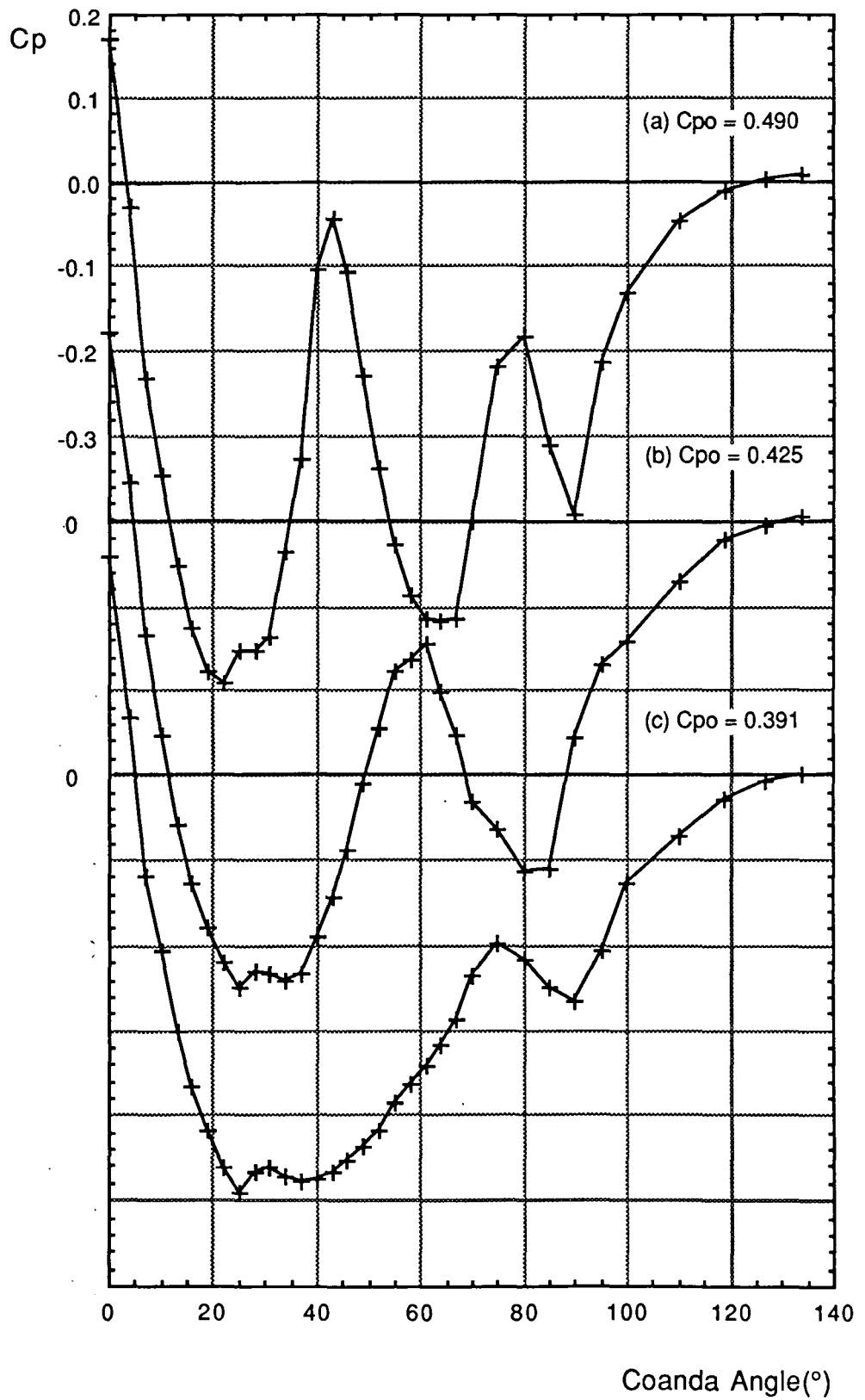


Figure 7.1.27.

Planar Coanda Model  
Experimental Surface Pressures

Slot = 8.00 mm; Step = 0.00 mm

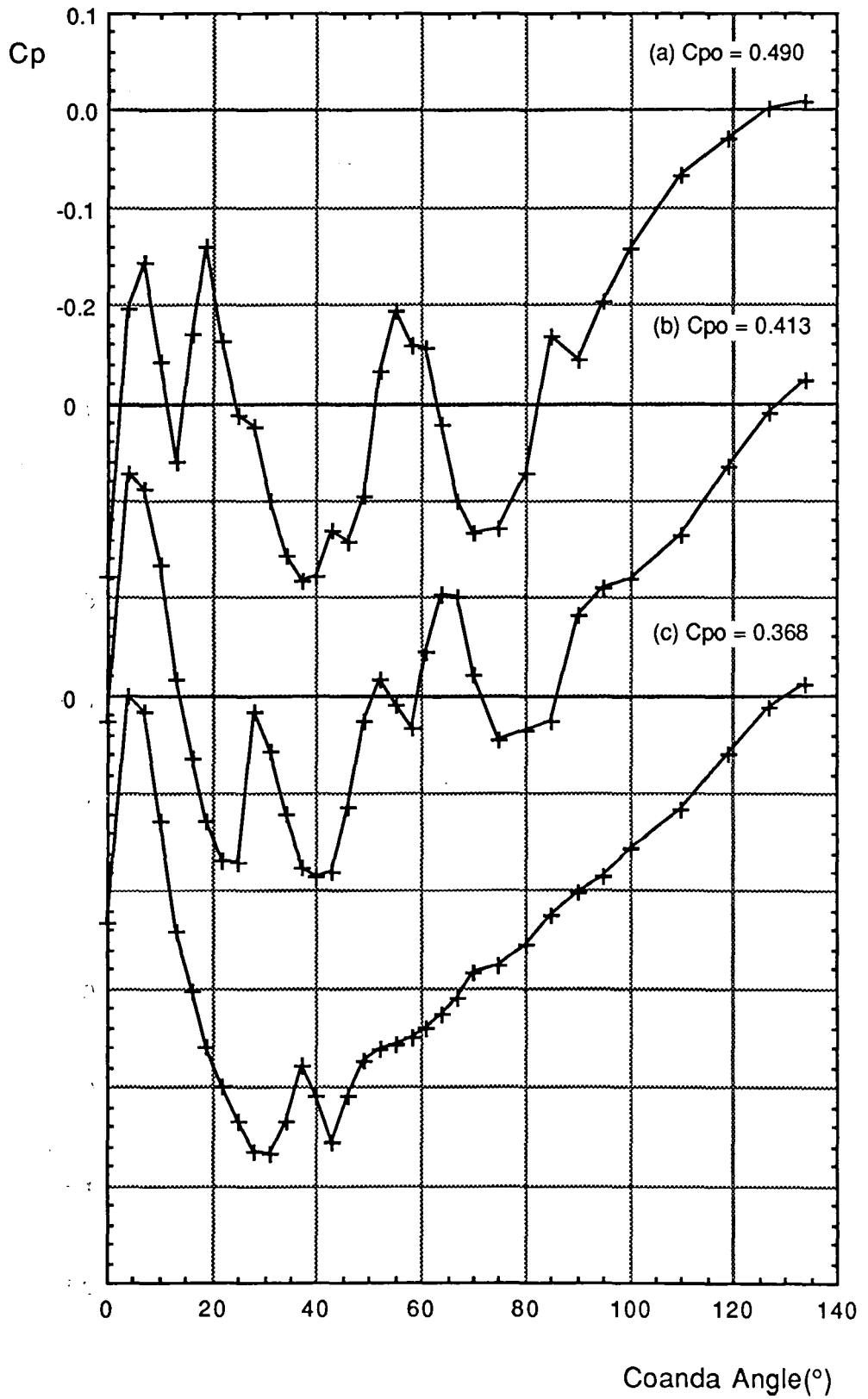


Figure 7.1.28.

Planar Coanda Model  
 Experimental Surface Pressures

Slot = 8.00 mm; Step = 0.75 mm

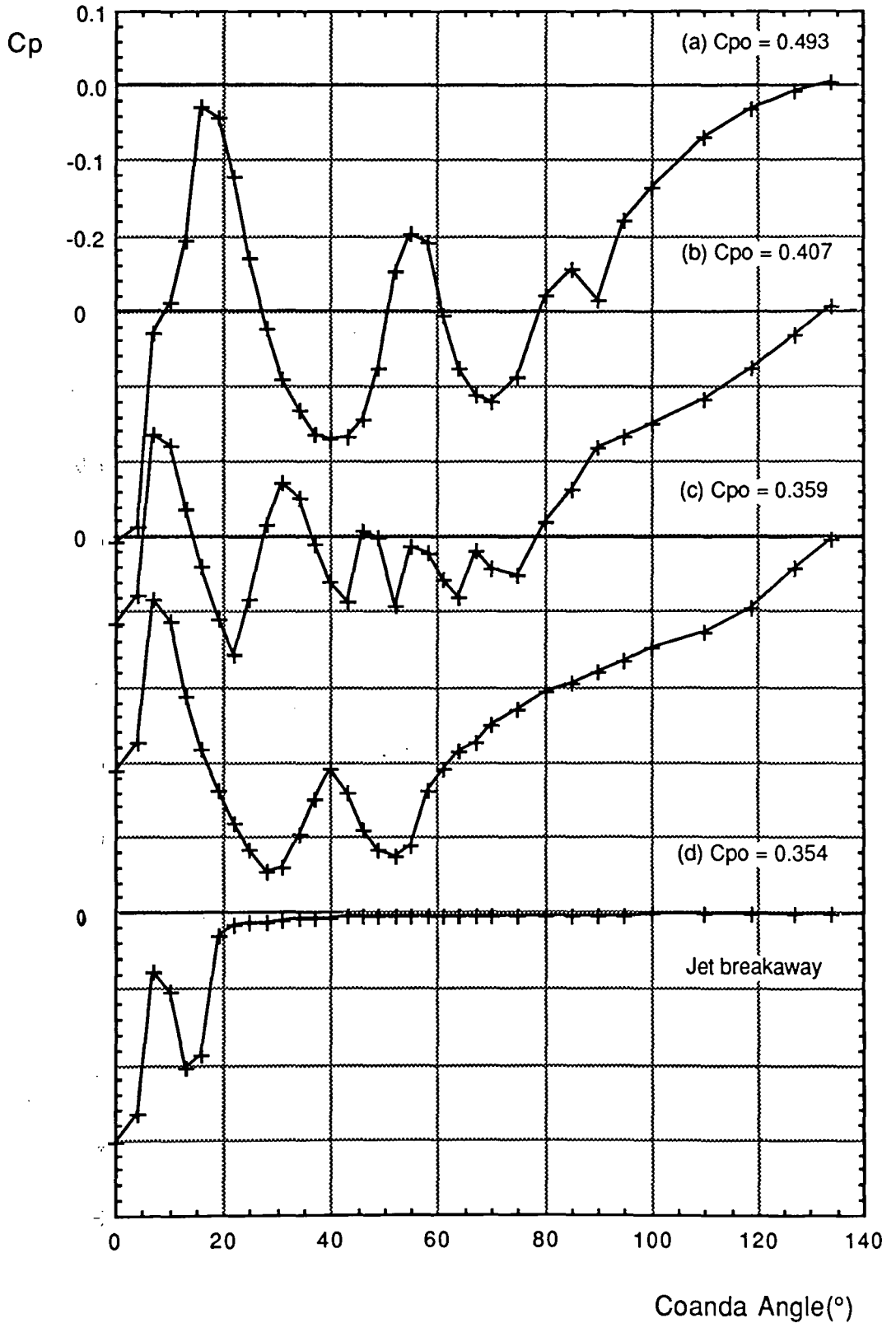


Figure 7.1.29.

Planar Coanda Model  
 Experimental Surface Pressures

Slot = 8.00 mm; Step = 1.50 mm



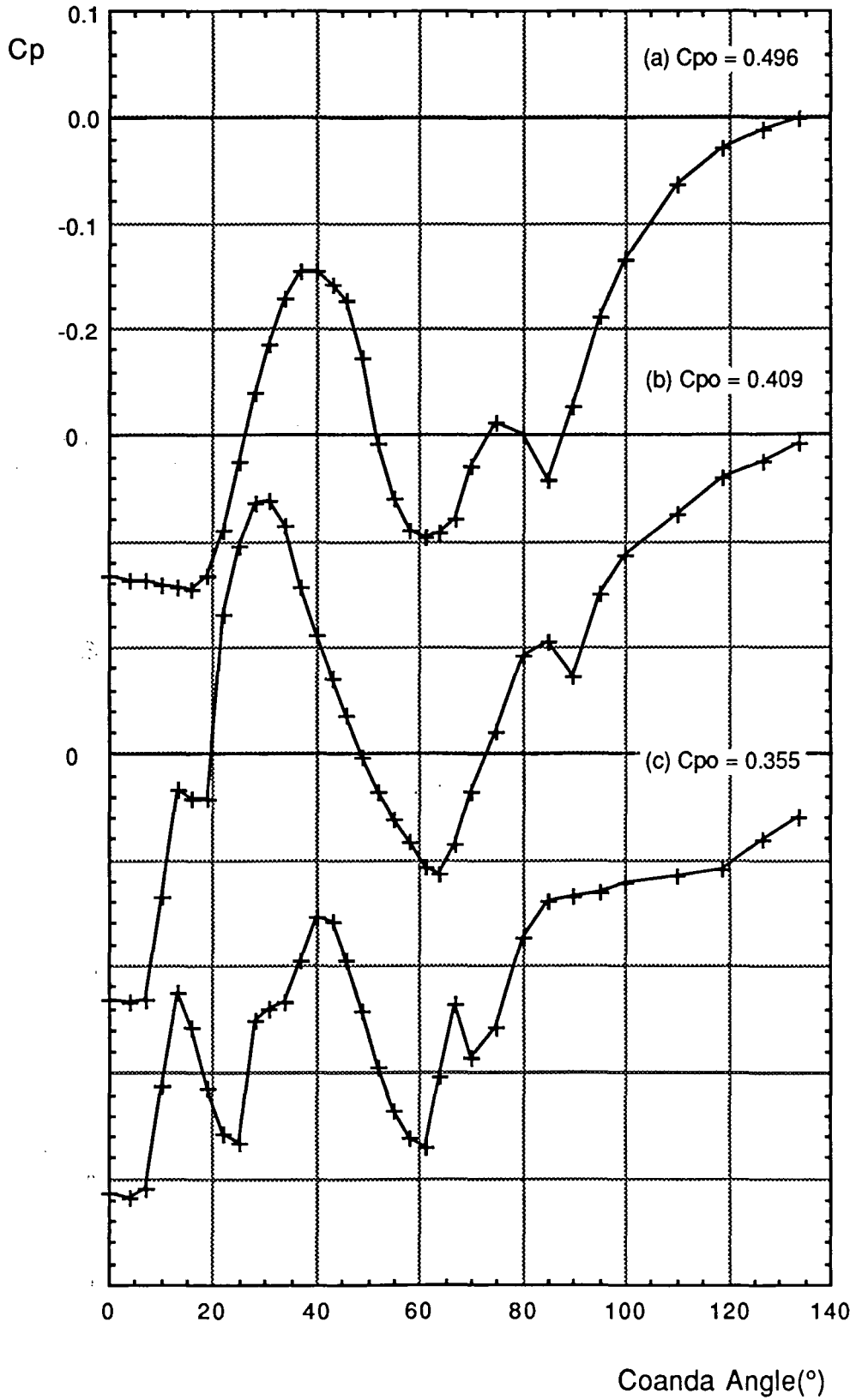


Figure 7.1.30.

Planar Coanda Model  
 Experimental Surface Pressures  
 Slot = 8.00 mm; Step = 3.75 mm

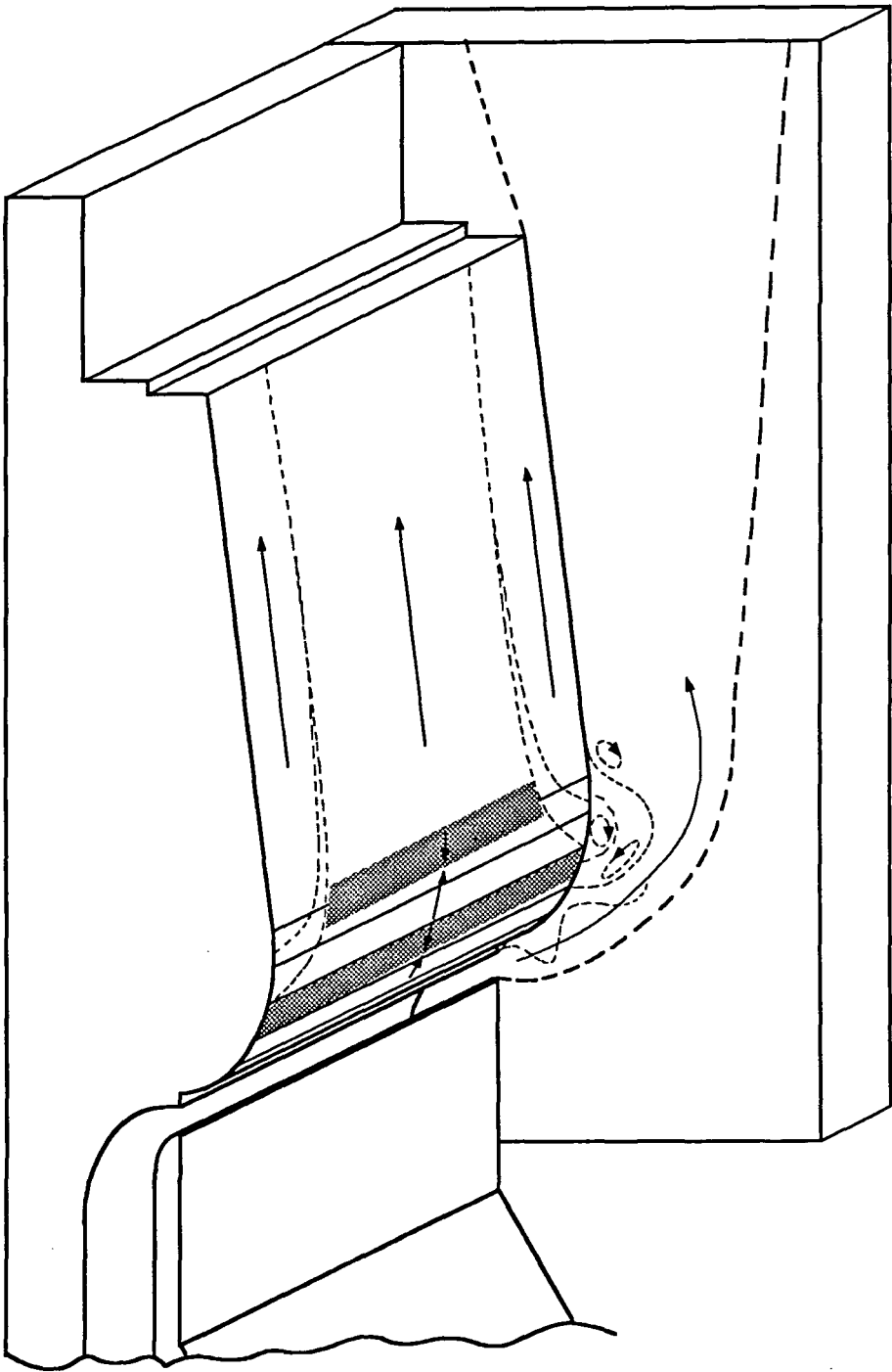


Figure 7.1. 31. Planar Flare Model Endwall Flow

Base Pressure  
[Pa]

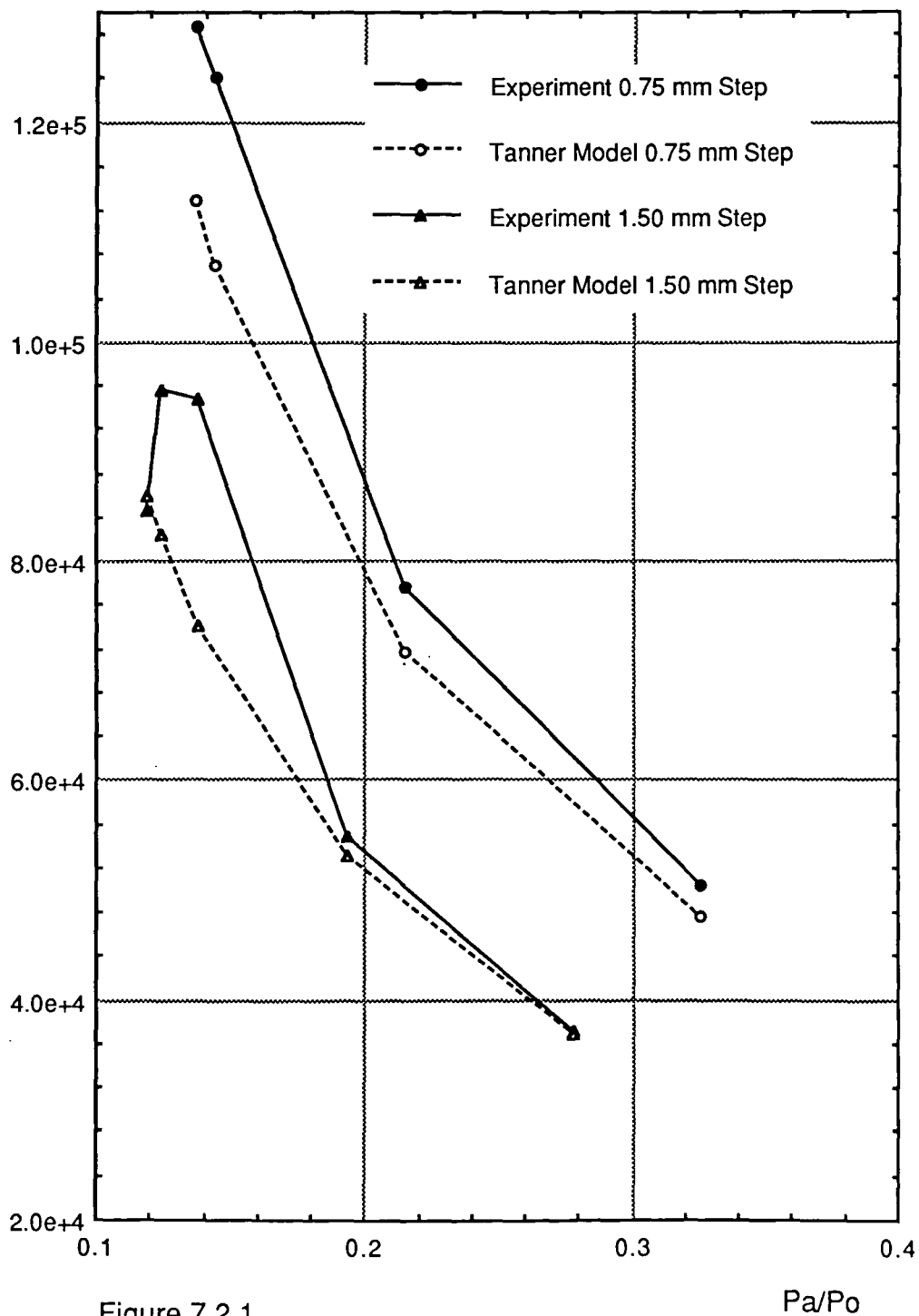


Figure 7.2.1.

Planar Coanda Model  
Base Pressures: 2.00 mm Slot

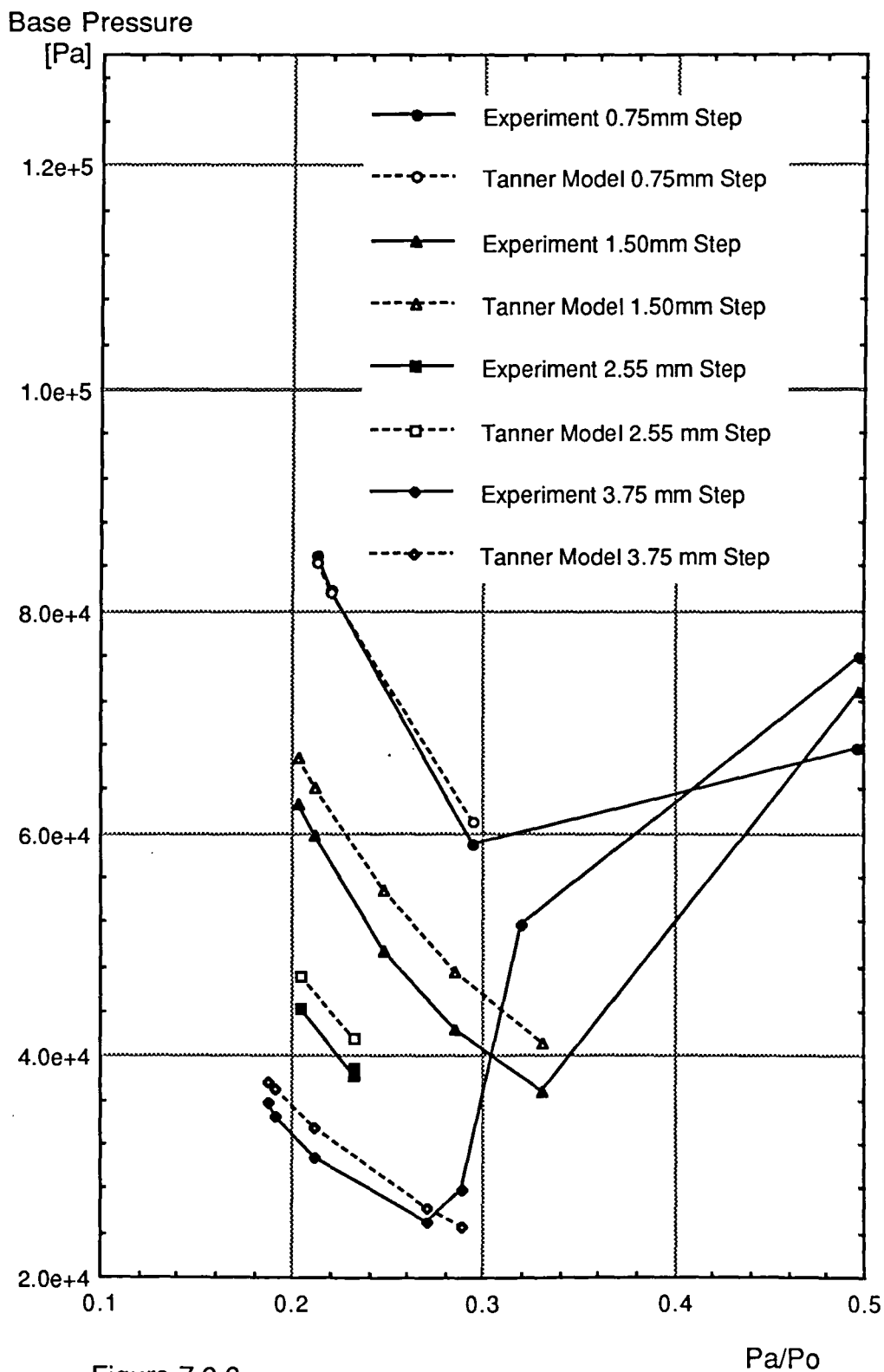


Figure 7.2.2.

Planar Coanda Model  
 Base Pressures: 4.00 mm Slot

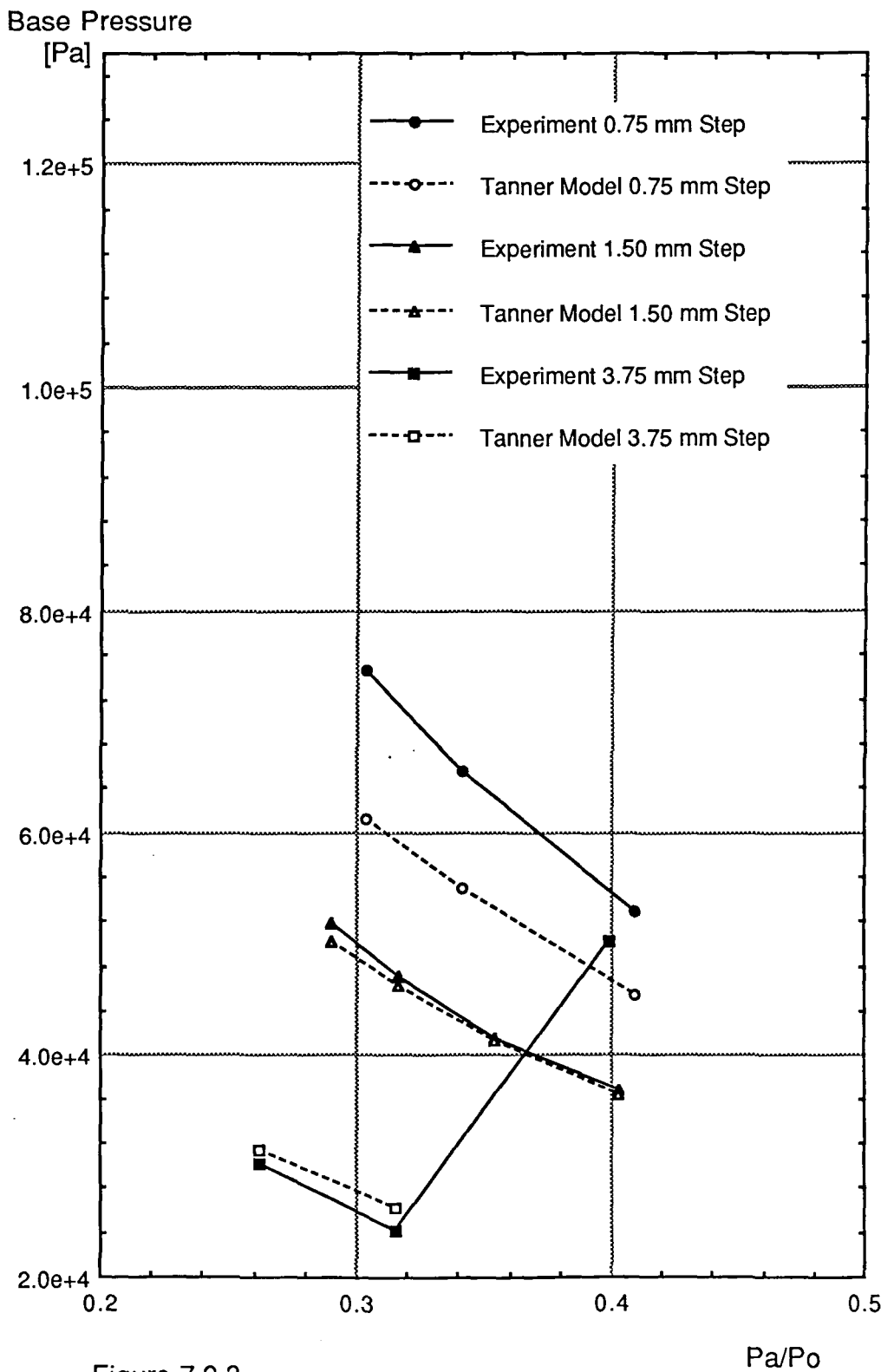


Figure 7.2.3.

Planar Coanda Model  
 Base Pressures: 6.00 mm Slot

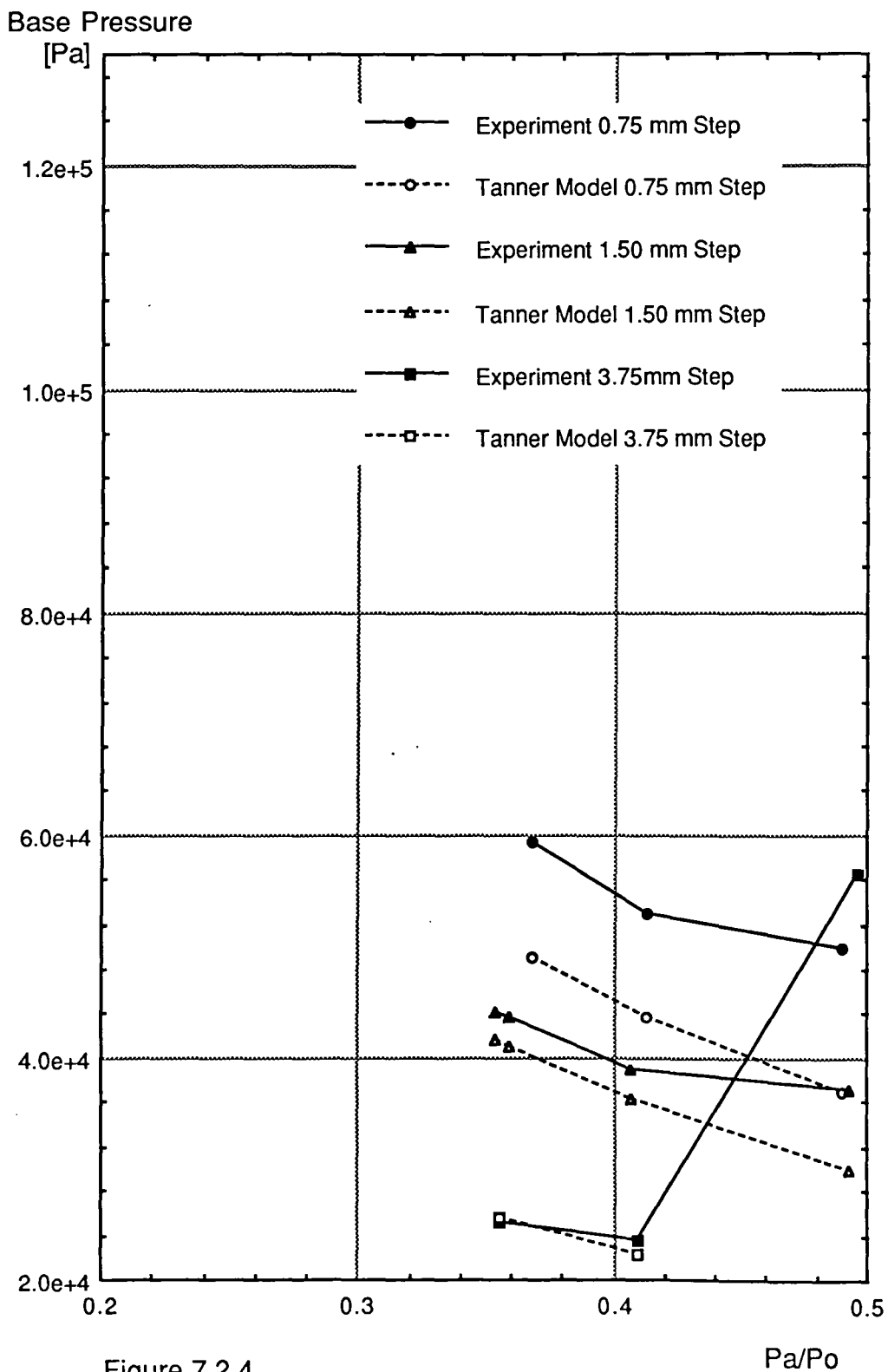


Figure 7.2.4.

Planar Coanda Model  
 Base Pressures: 8.00 mm Slot

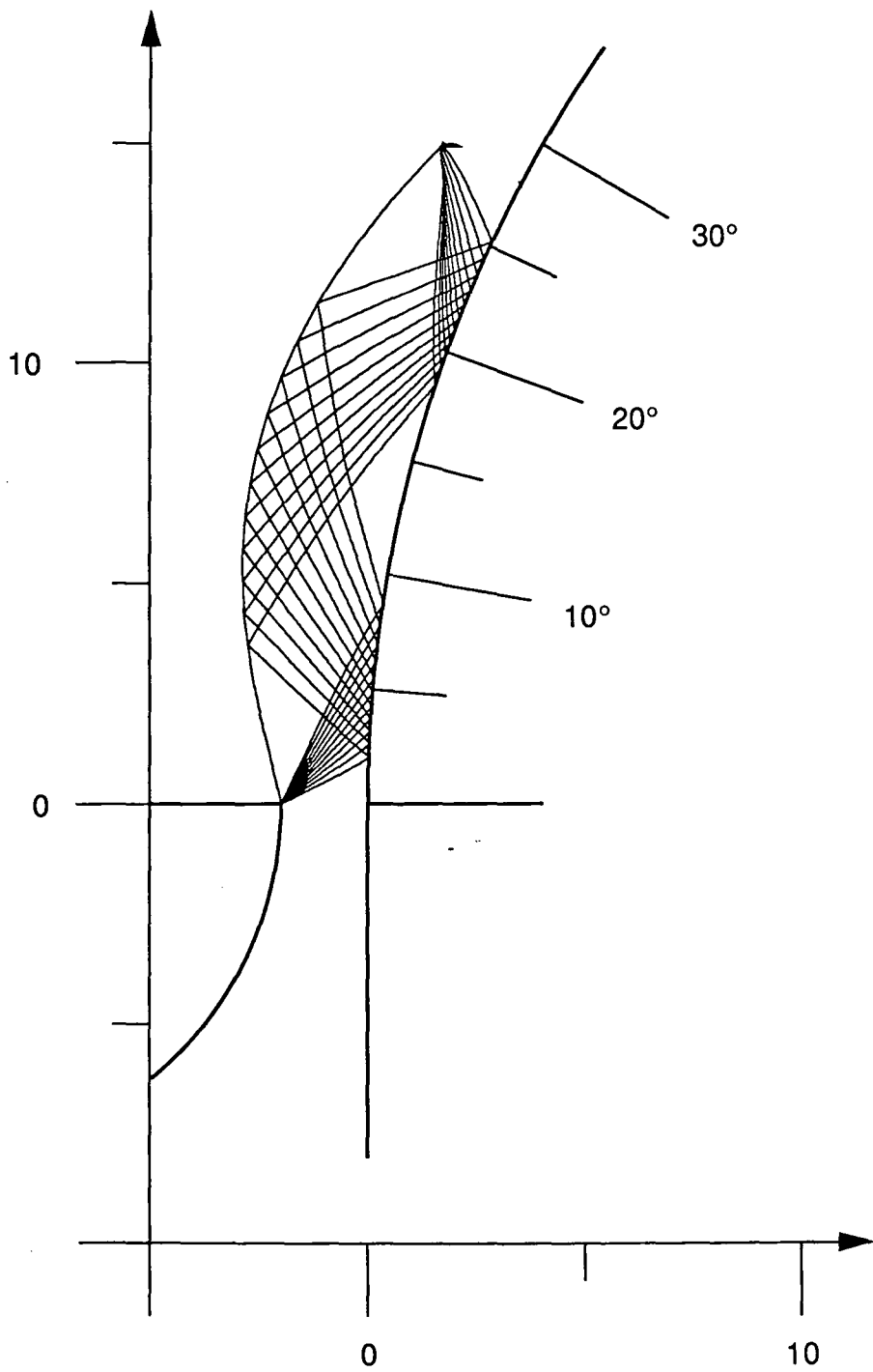


Figure 7.2.5.

Planar Coanda Model  
Method of Characteristics Plot

Attached Jet; Shock Fitting

Slot = 2.00 mm    Step = 0.00 mm

$P_{atm}/P_o = 0.243$

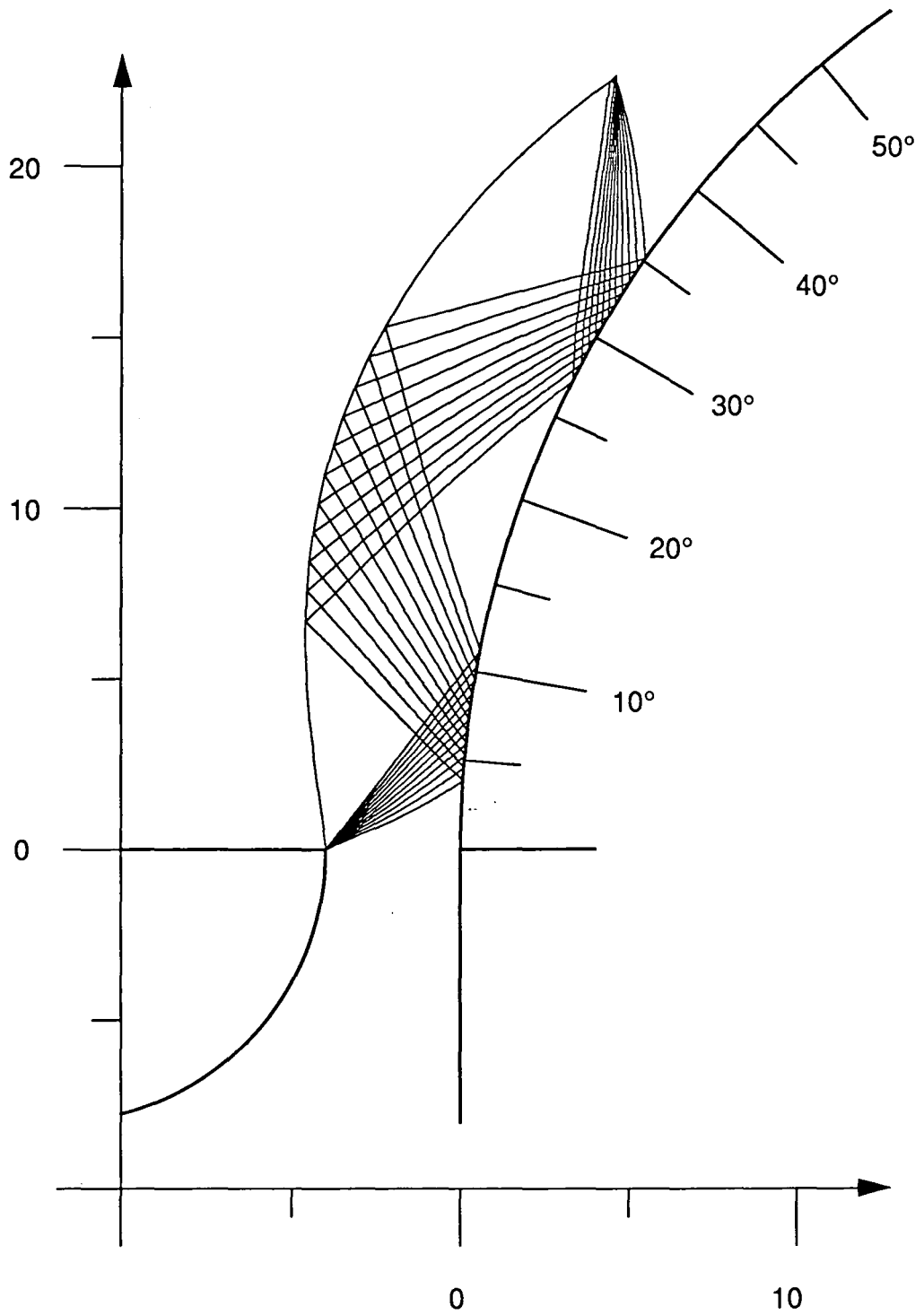


Figure 7.2.6.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting

Slot = 4.00 mm Step = 0.00 mm

Patm/Po = 0.324



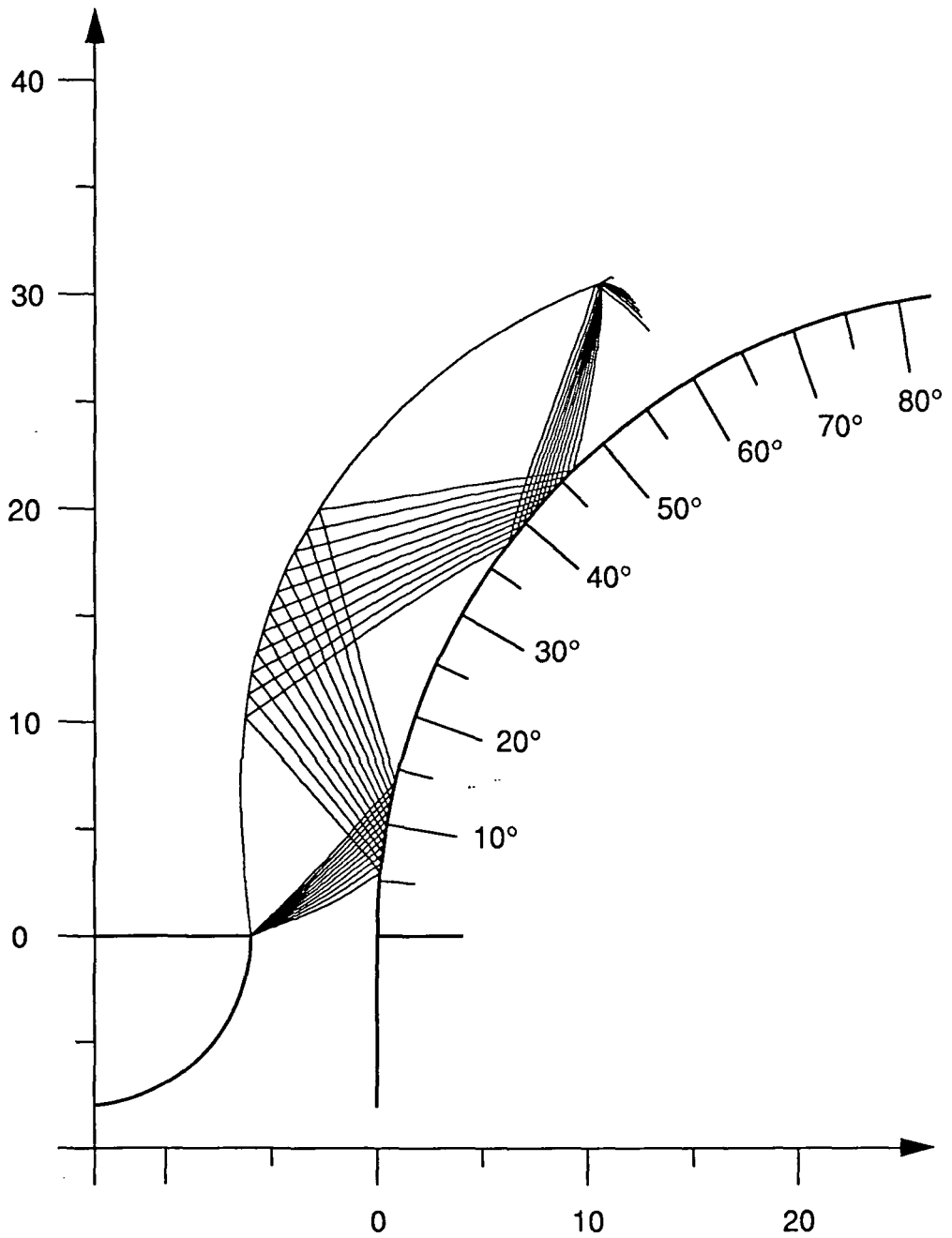


Figure 7.2.7.

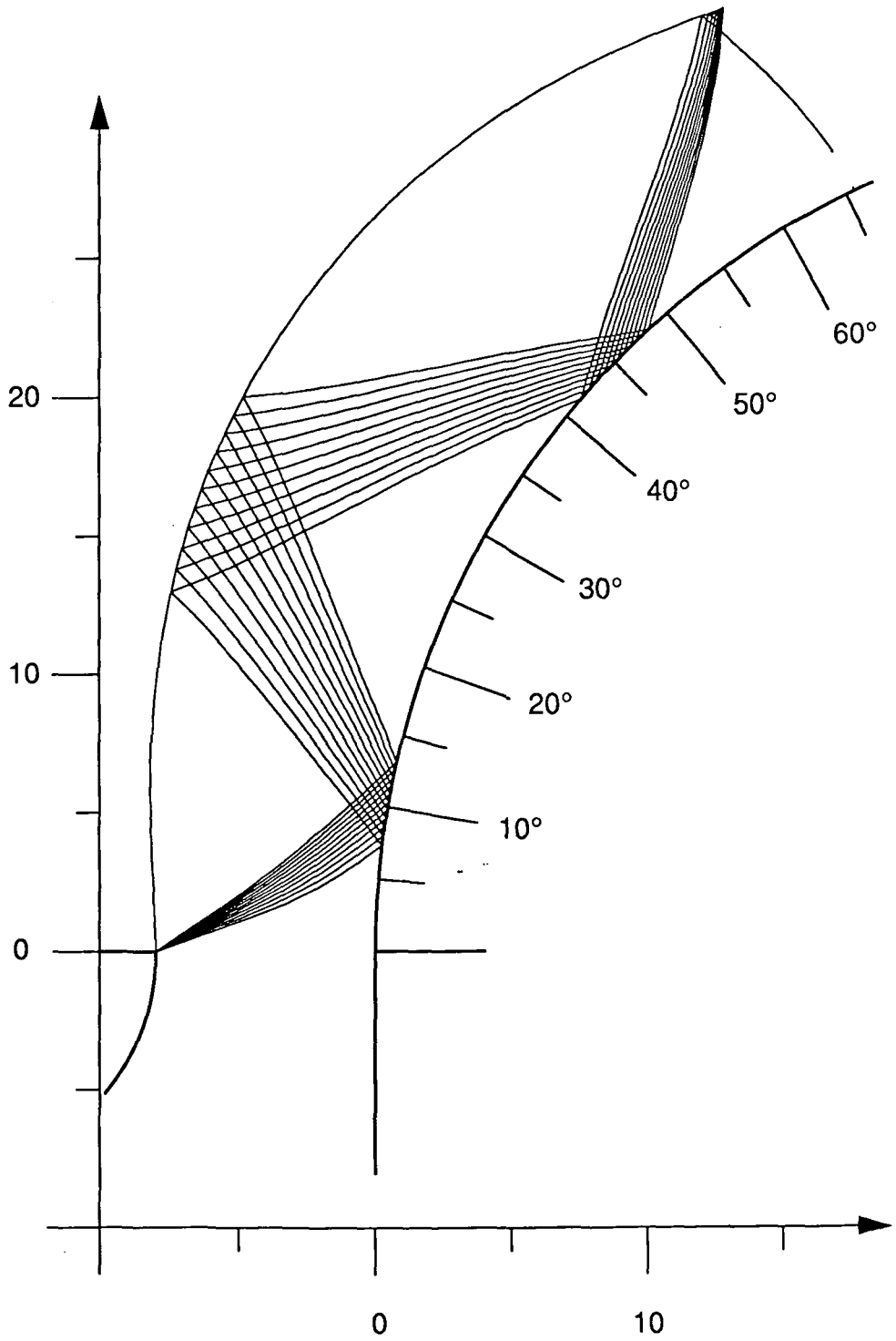
Planar Coanda Model

Method of Characteristics Plot

Shock Fitting

Slot = 6.00 mm    Step = 0.00 mm

$P_{atm}/P_o = 0.366$



**Figure 7.2.8.** Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting  
 Slot = 8.00 mm    Step = 0.00 mm  
 $P_{atm}/P_o = 0.425$

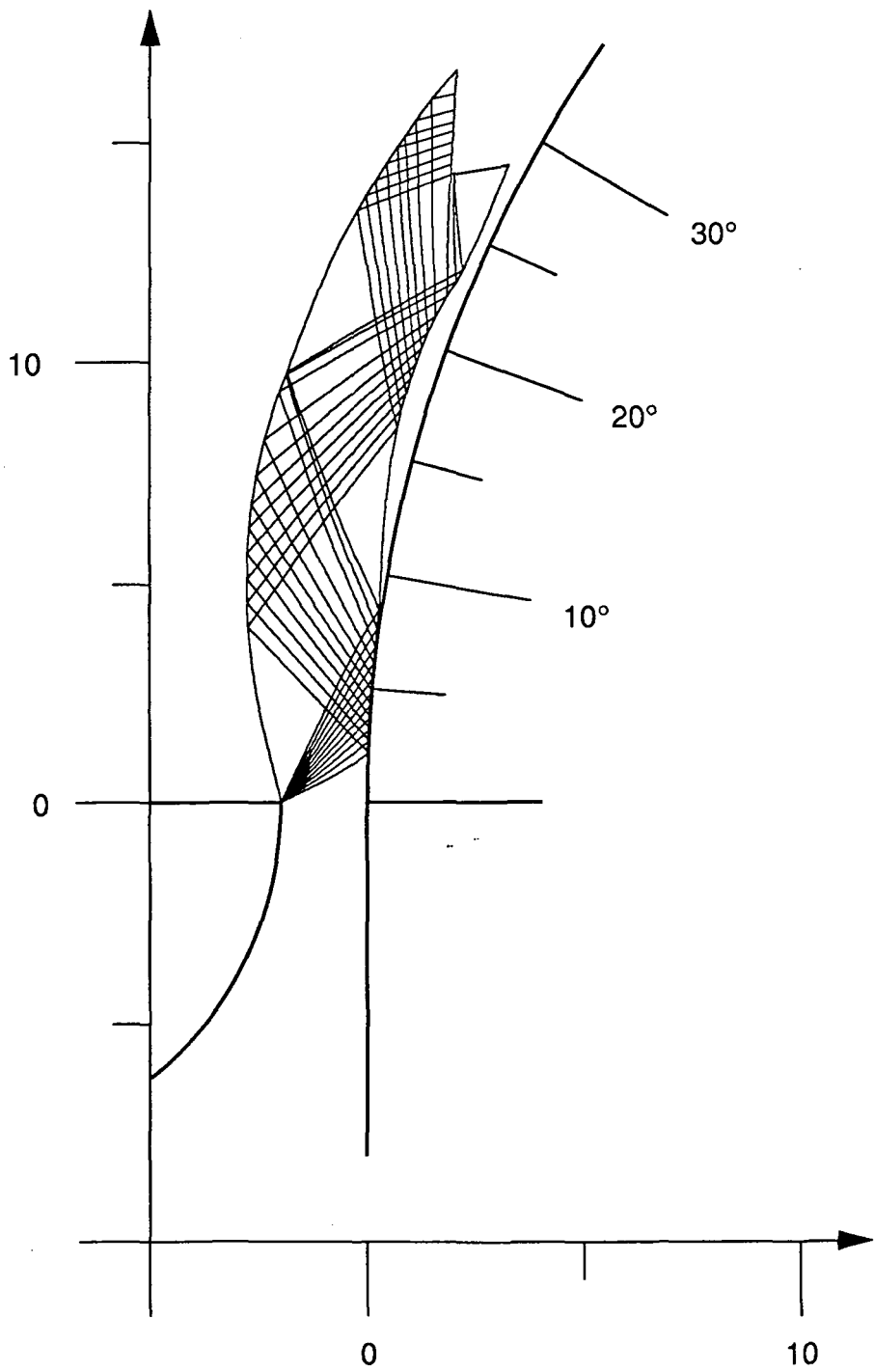


Figure 7.2.9. Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Experimental Surface Pressures  
 Slot = 2.00 mm    Step = 0.00 mm  
 $P_{atm}/P_o = 0.243$

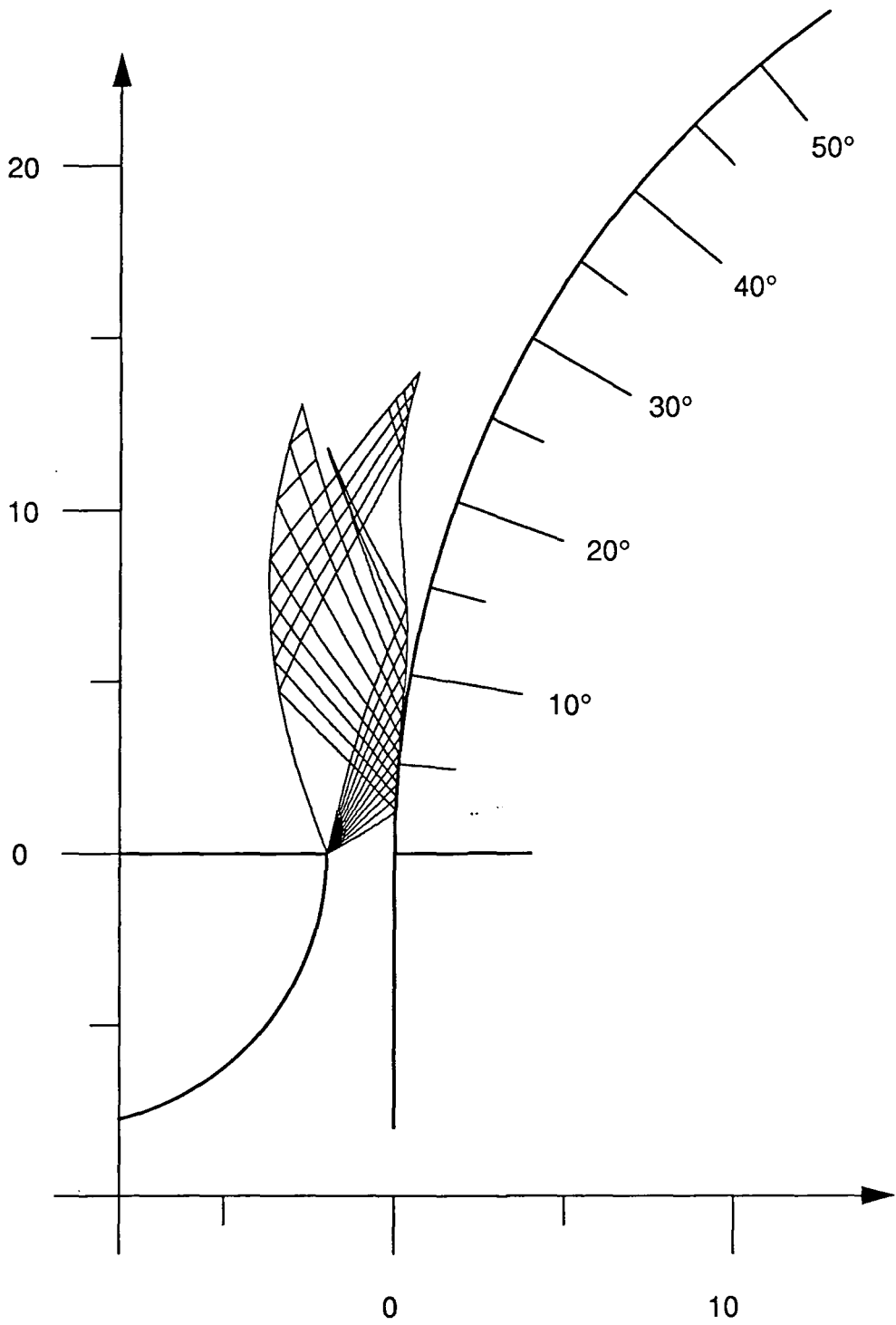


Figure 7.2.10. Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Experimental Surface Pressures  
 Slot = 2.00 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.176$

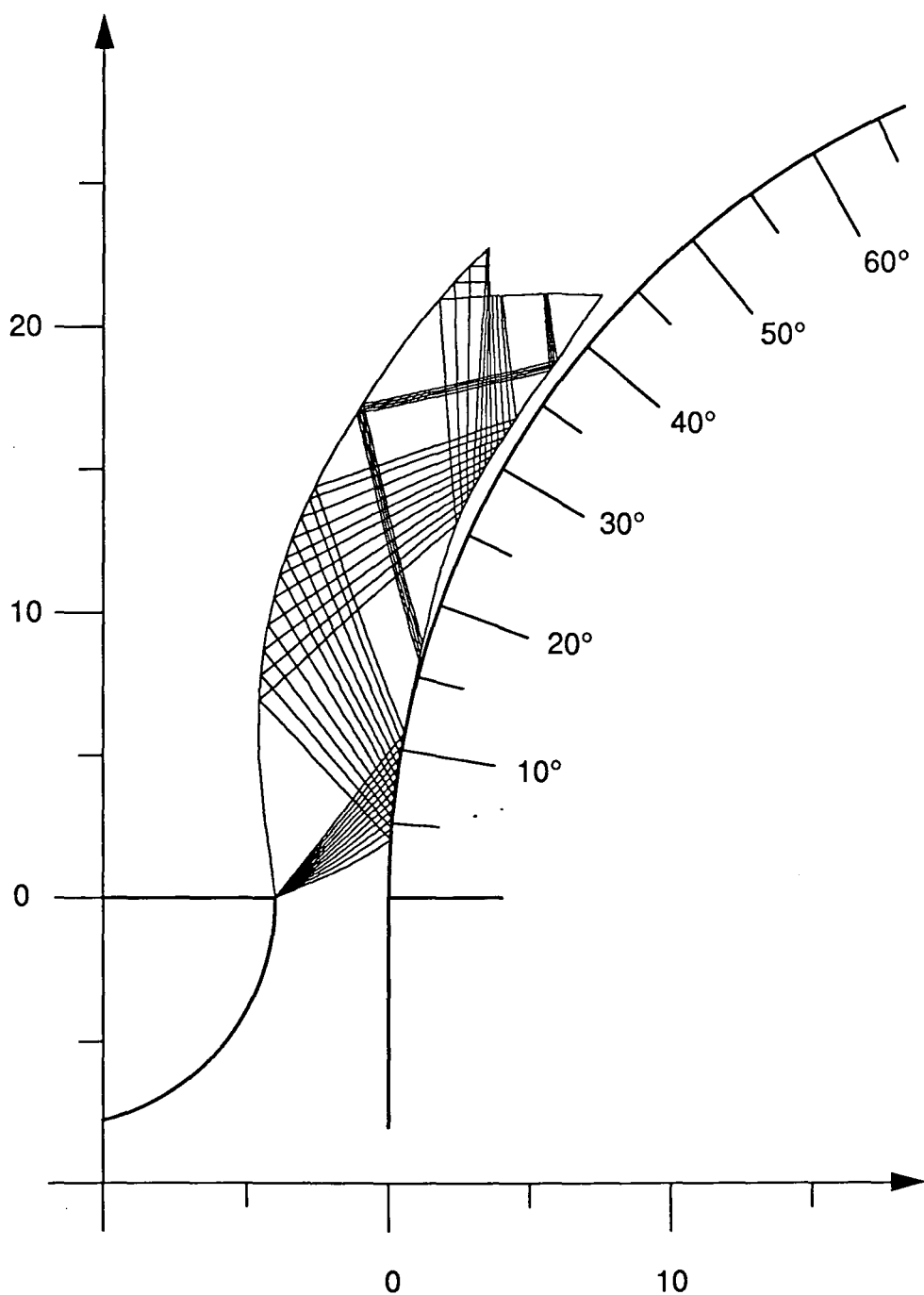


Figure 7.2.11.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Experimental Surface Pressures

Slot = 4.00 mm Step = 0.00 mm

Patm/Po = 0.324

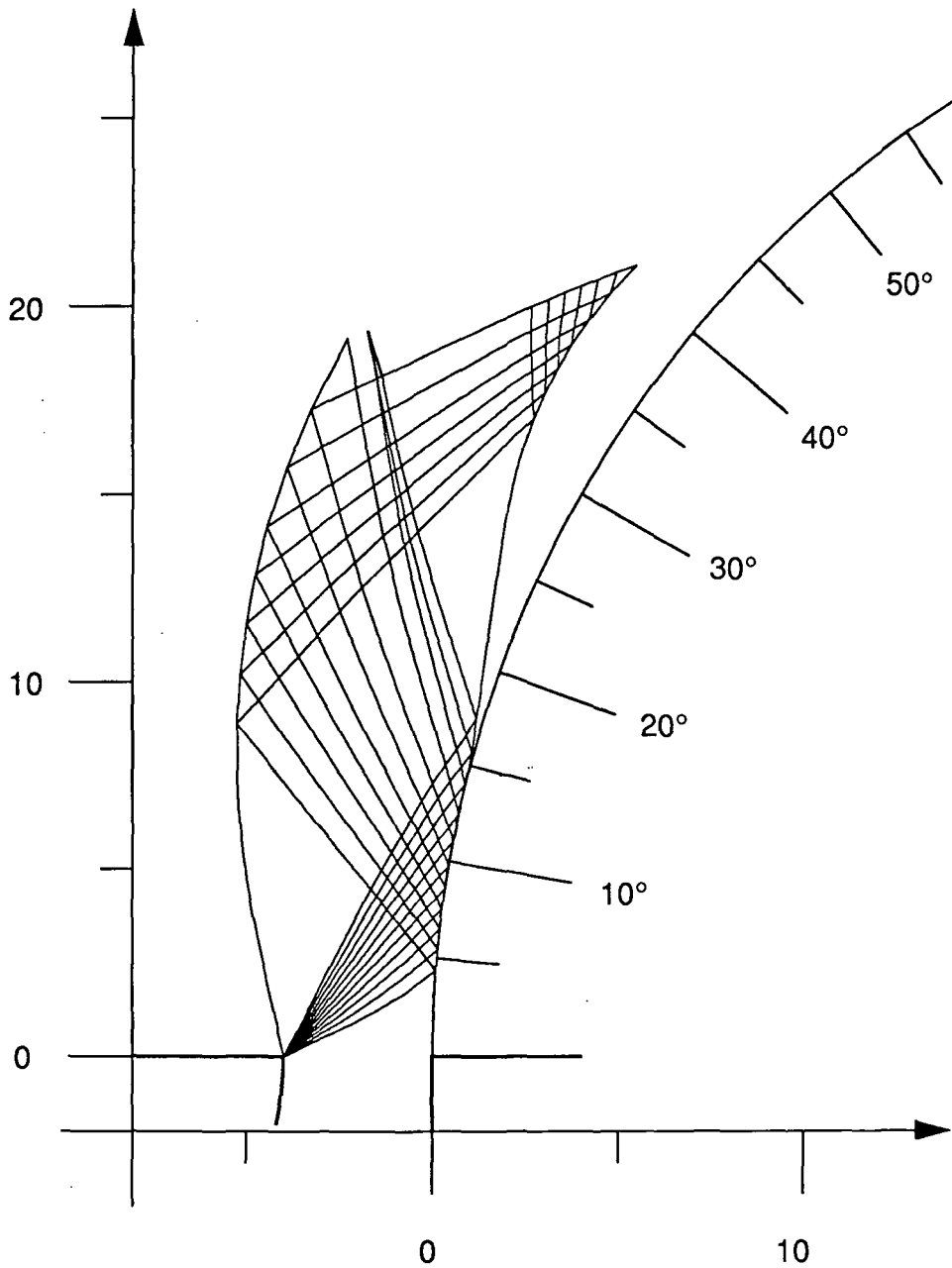


Figure 7.2.12.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Experimental Surface Pressures

Slot = 4.00 mm Step = 0.00 mm

$P_{atm}/P_o = 0.256$

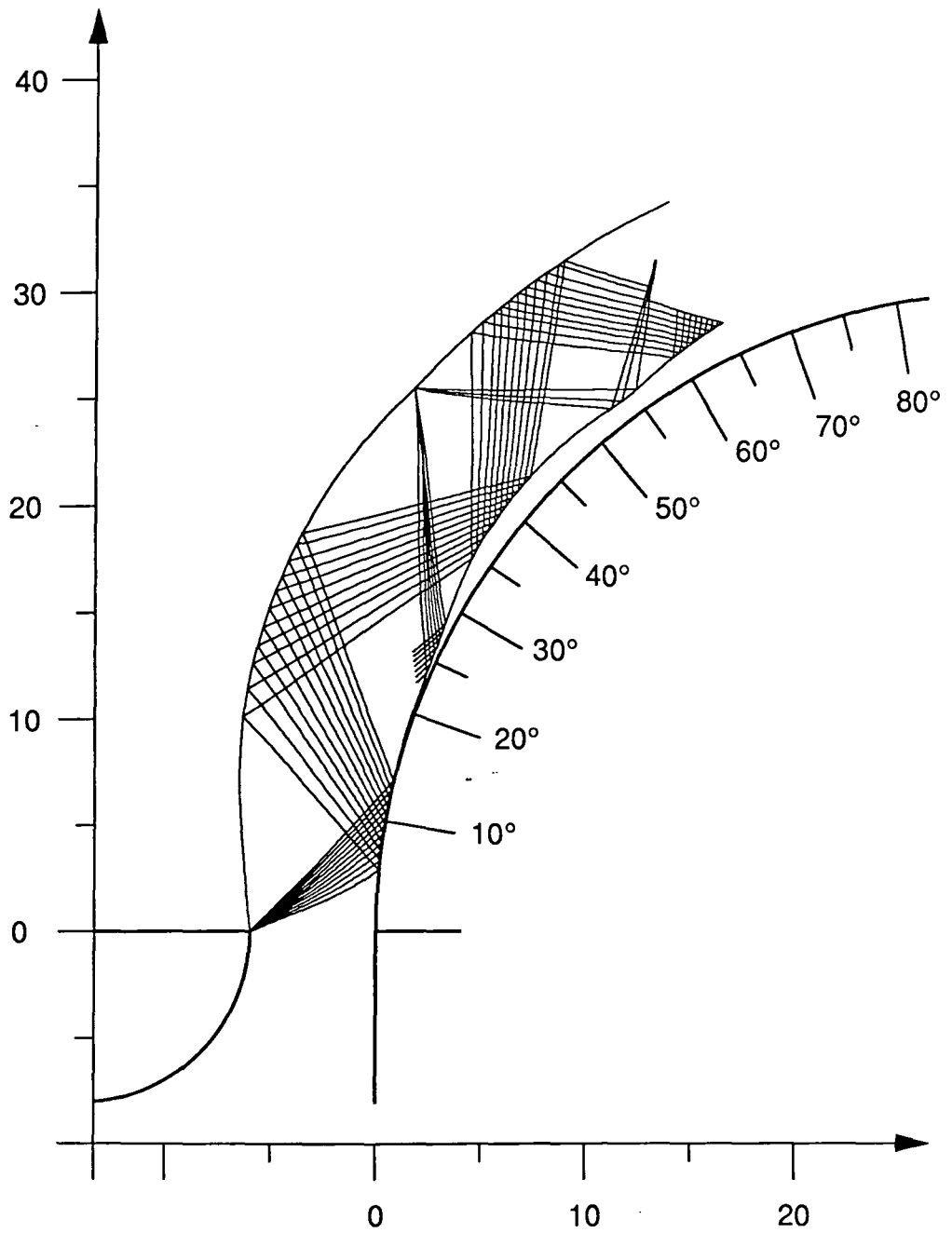


Figure 7.2.13.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Experimental Surface Pressures

Slot = 6.00 mm Step = 0.00 mm

$P_{atm}/P_o = 0.366$

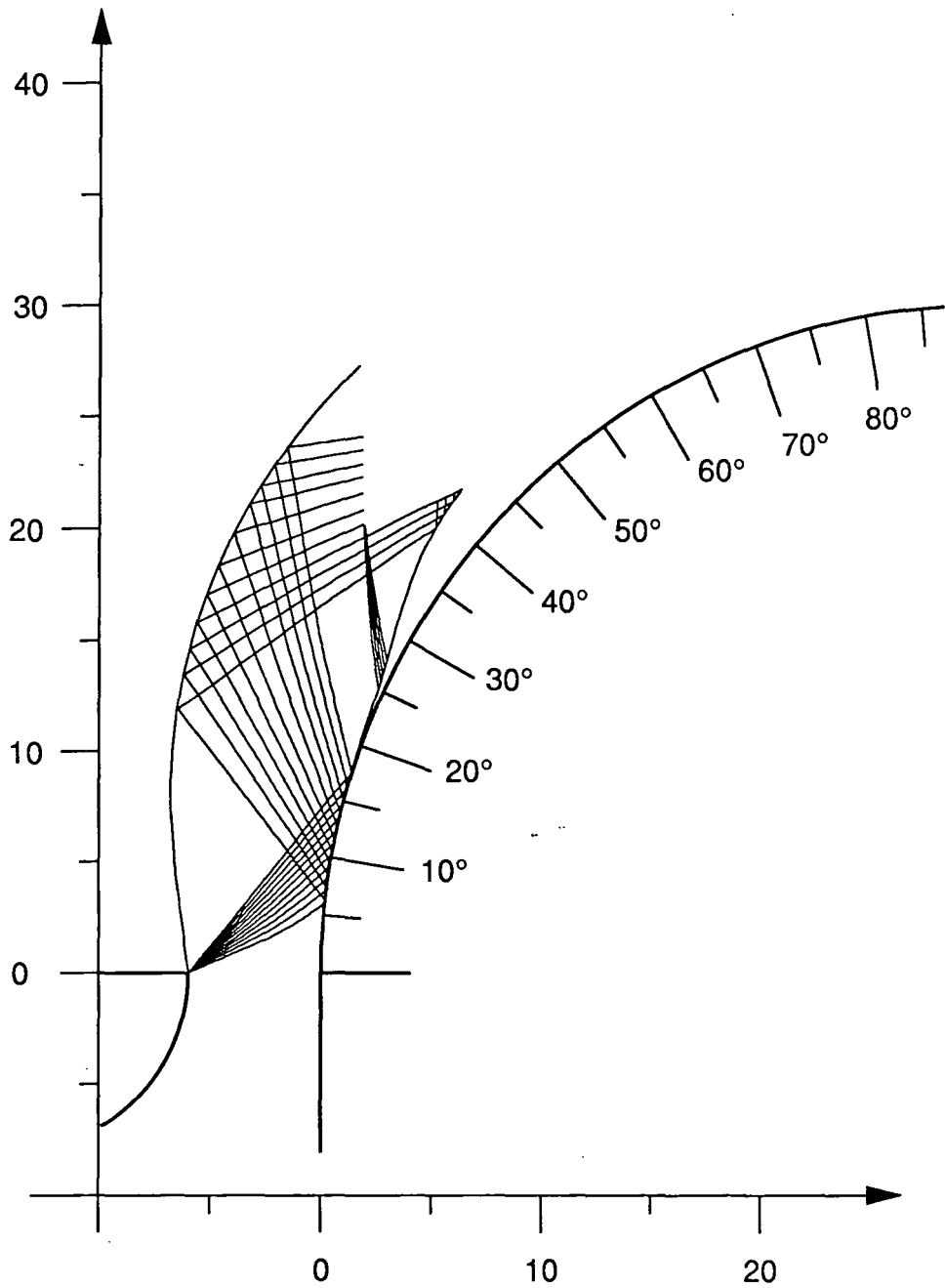


Figure 7.2.14.

Planar Coanda Model

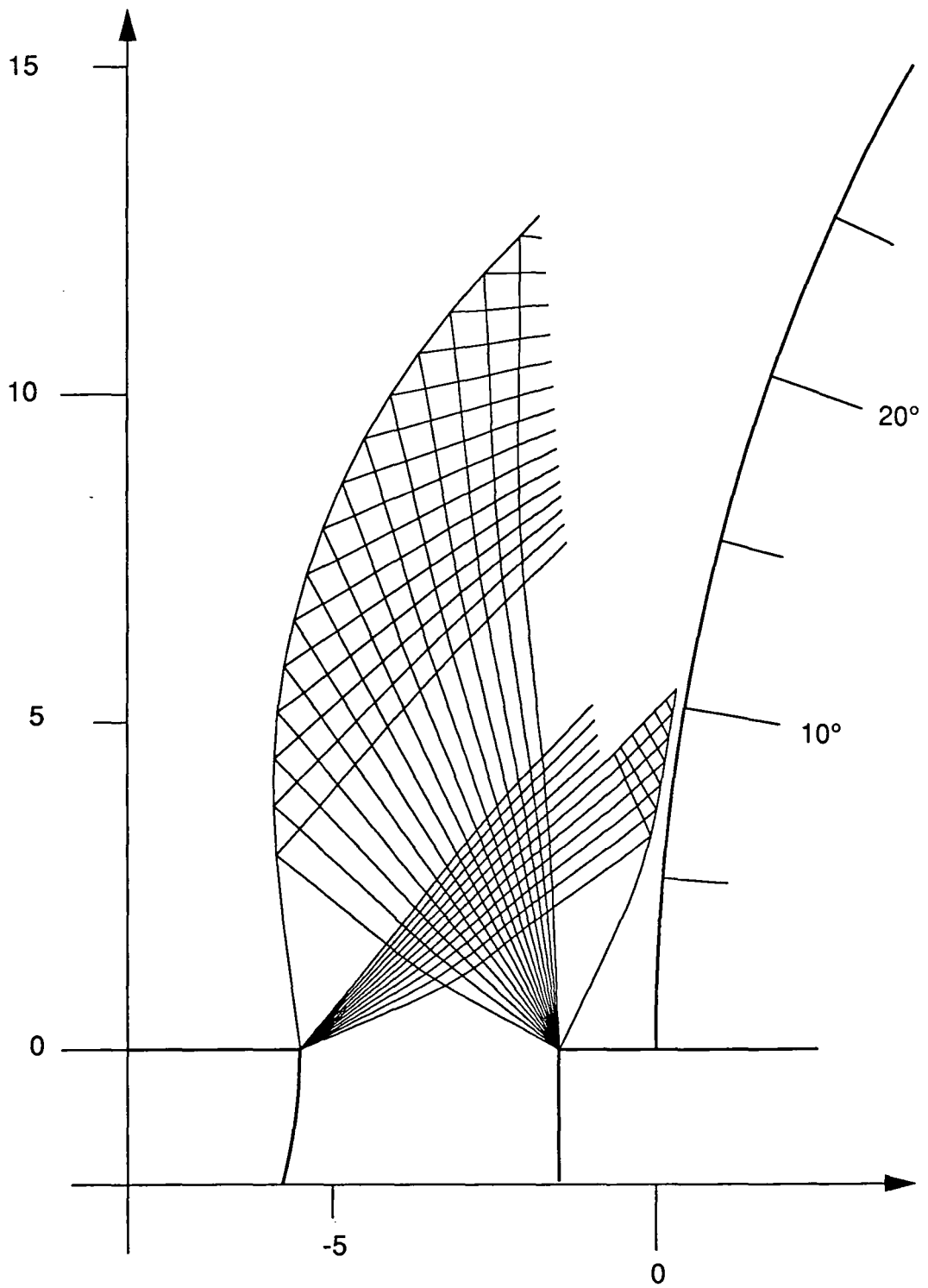
Method of Characteristics Plot

Shock Fitting; Experimental Surface Pressures

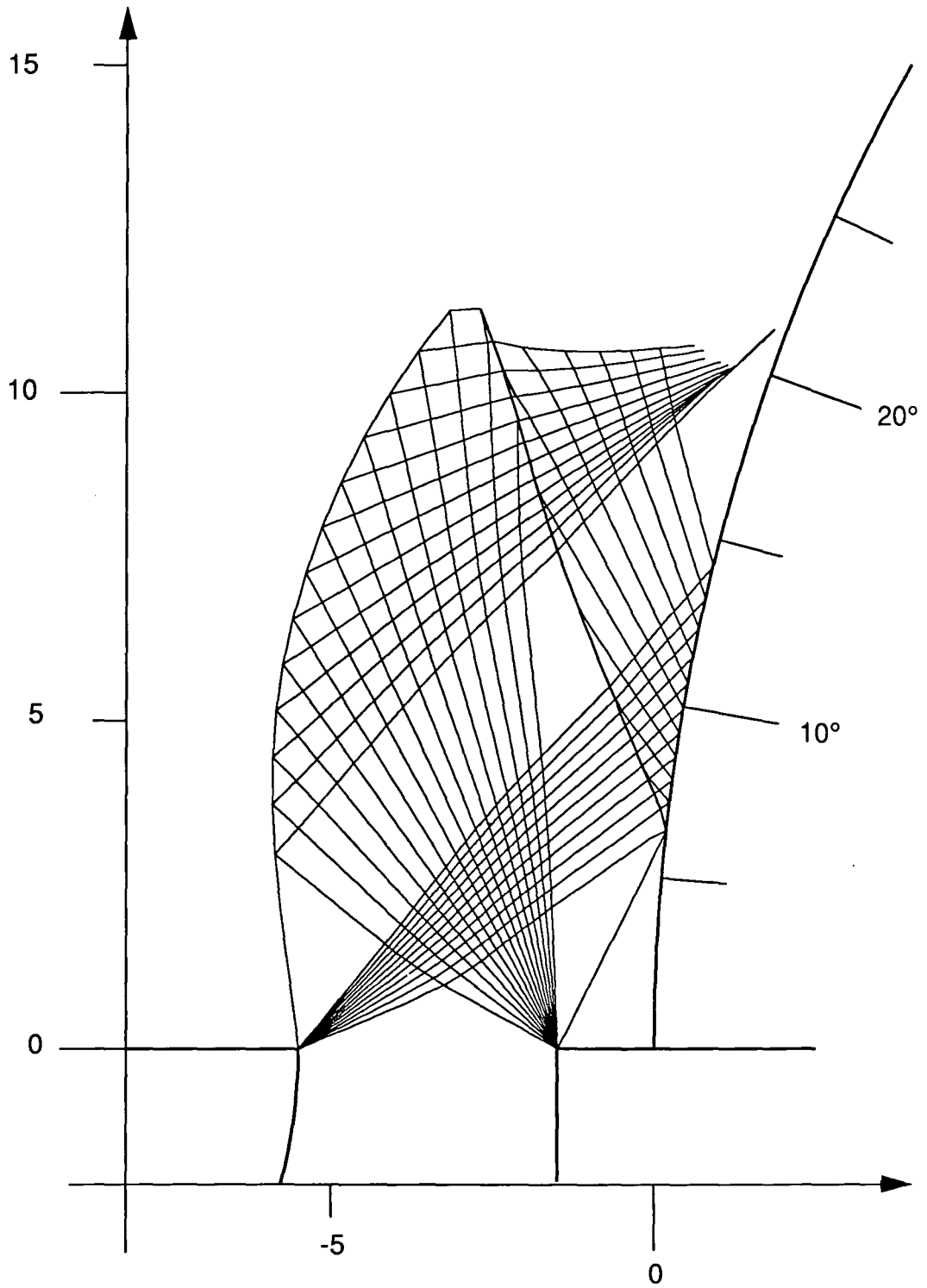
Slot = 6.00 mm Step = 0.00 mm

Patm/Po = 0.330





**Figure 7.2.15.** Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Experimental Surface Pressures  
 Slot = 4.00 mm    Step = 1.50 mm  
 $P_{atm}/P_o = 0.331$



**Figure 7.2.16.** Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Experimental Base Pressure  
 Slot = 4.00 mm    Step = 1.50 mm  
 $P_{atm}/P_o = 0.331$

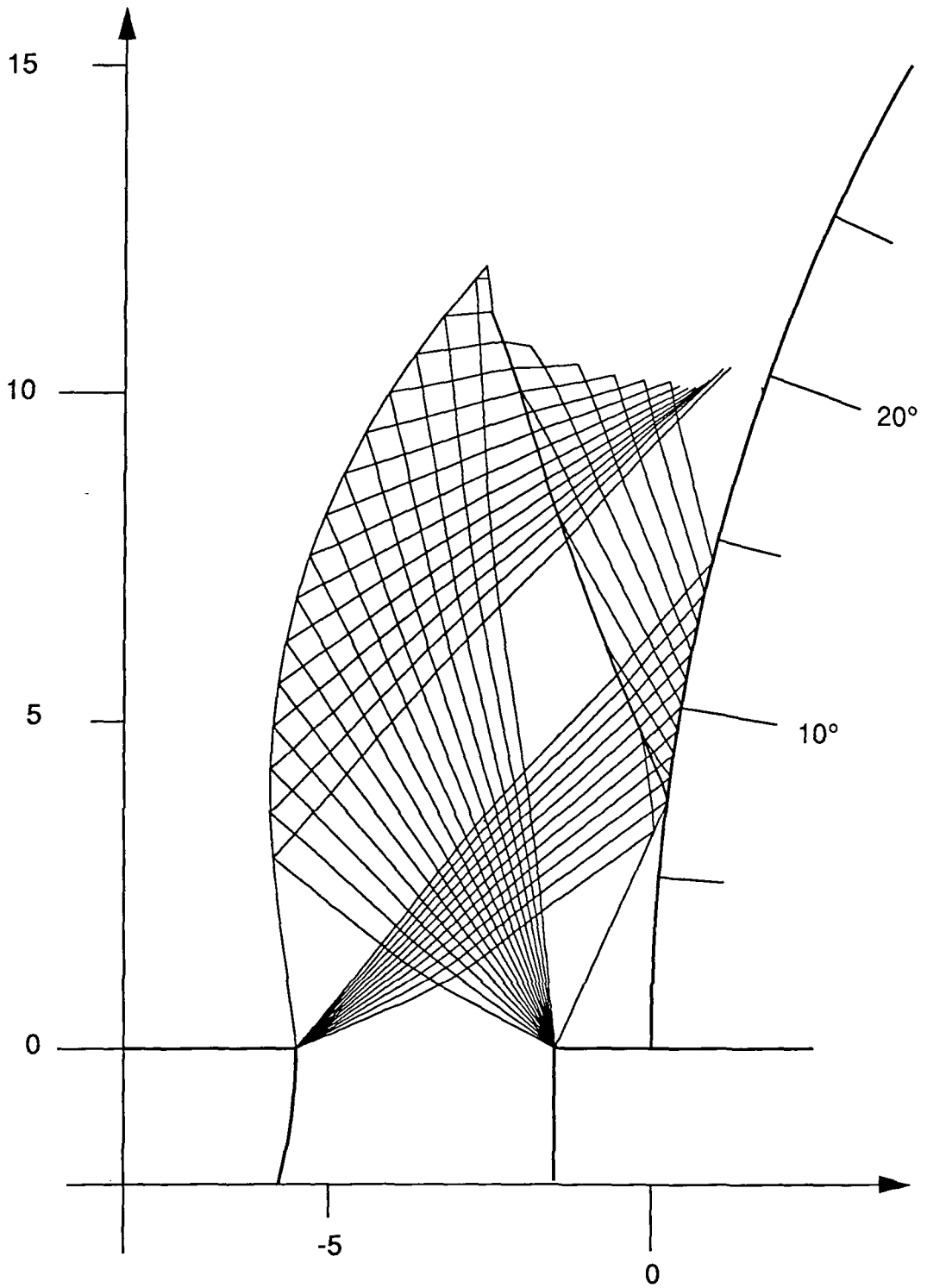
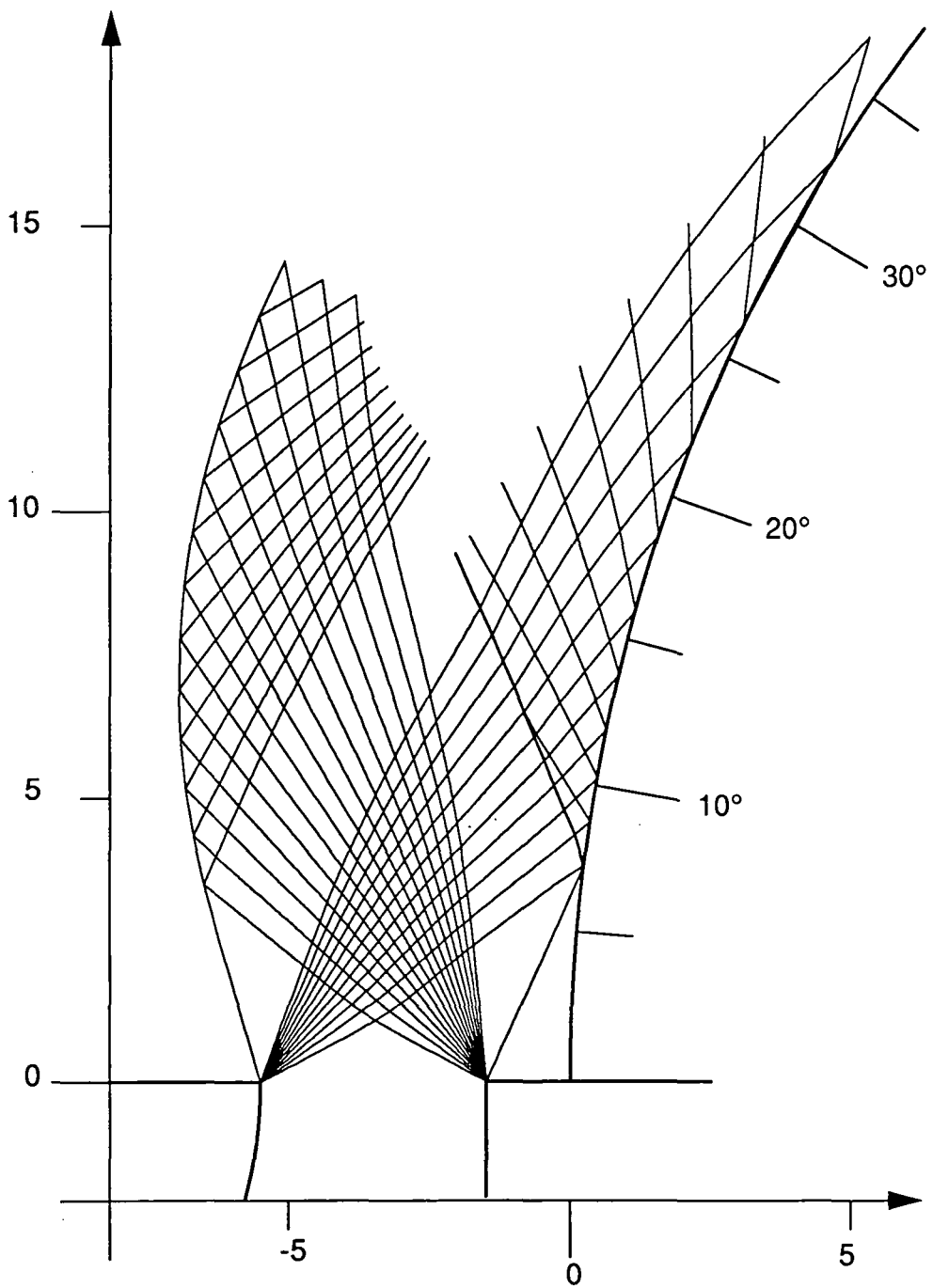


Figure 7.2.17. Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Base Pressure Model  
 Slot = 4.00 mm    Step = 1.50 mm  
 $P_{atm}/P_o = 0.331$



**Figure 7.2.18.** Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Base Pressure Model  
 Slot = 4.00 mm    Step = 1.50 mm  
 $P_{atm}/P_o = 0.212$

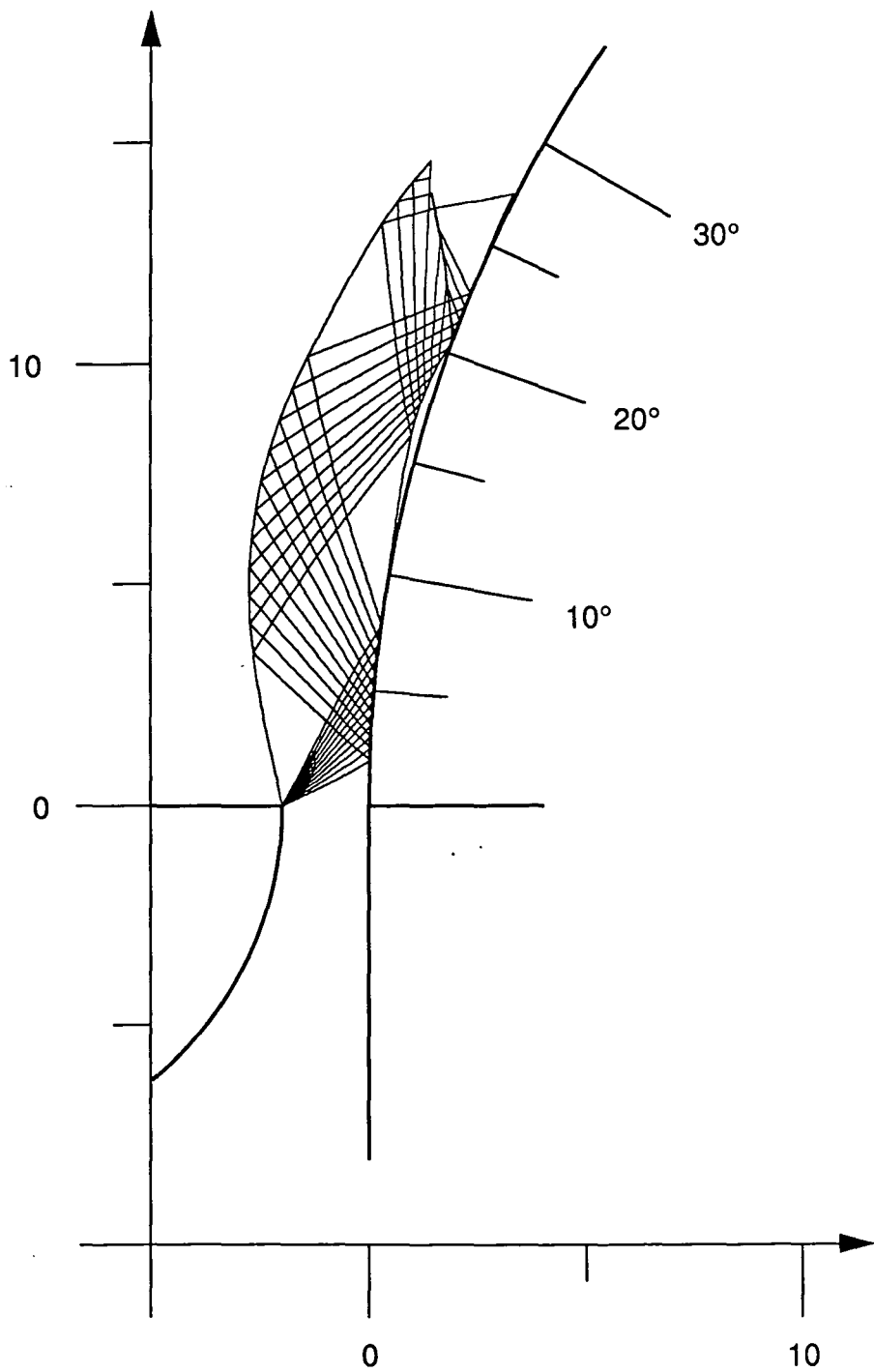


Figure 7.2.19.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 2.00 mm Step = 0.00 mm

$P_{atm}/P_o = 0.258$

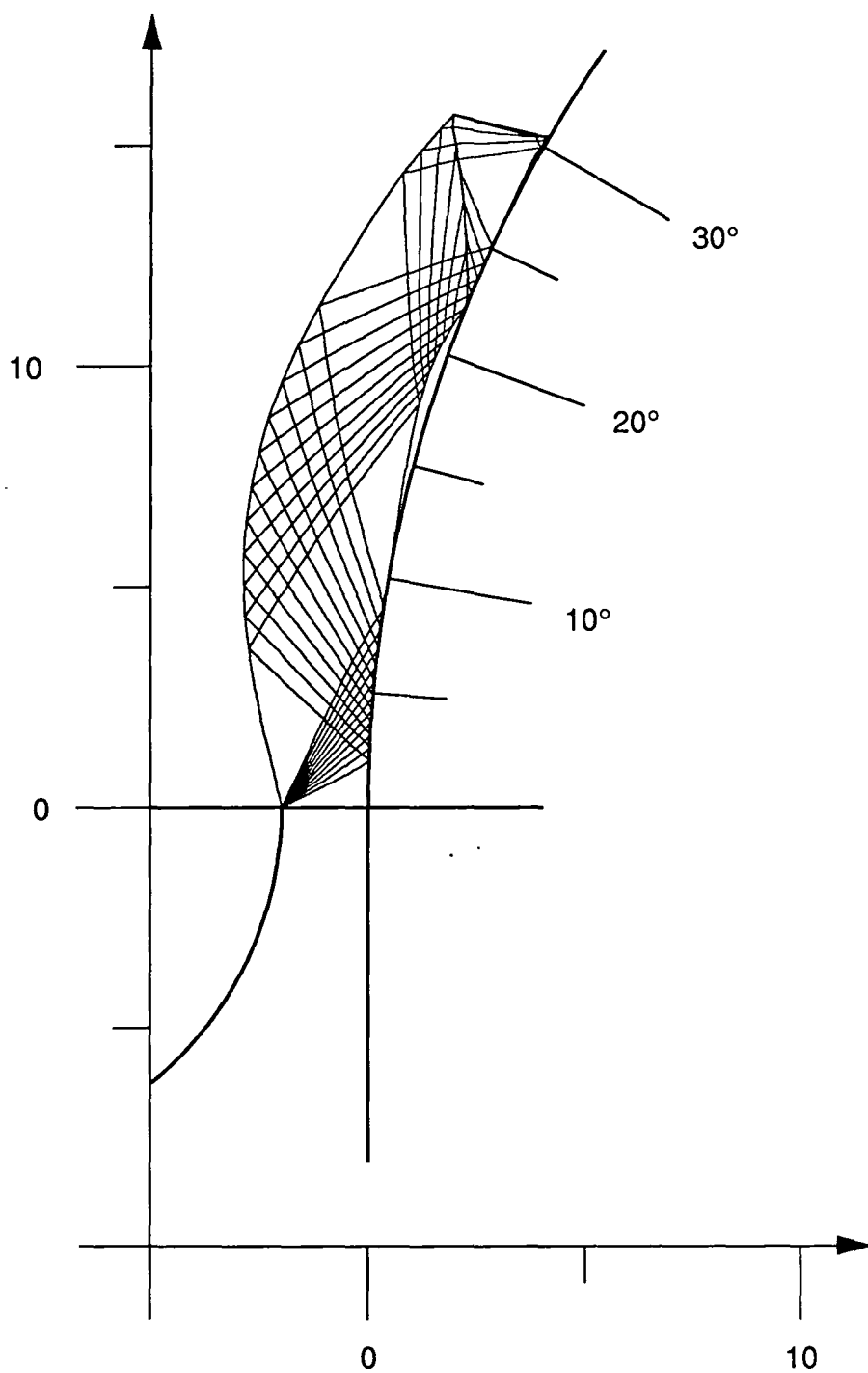


Figure 7.2.20.

Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Step = 2.00mm Slot = 0.00mm  
 $P_{atm}/P_o = 0.243$

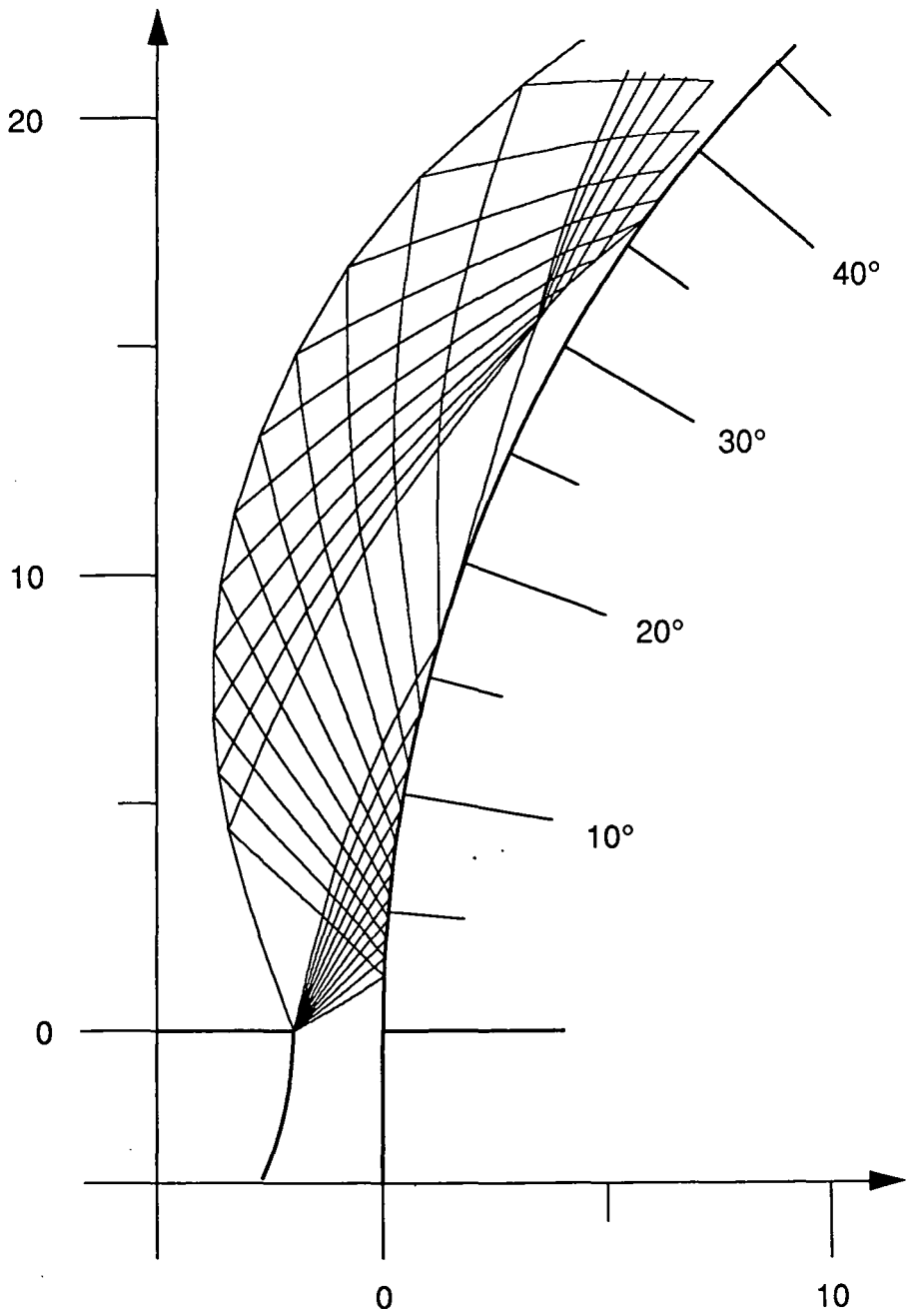


Figure 7.2.21.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 2.00 mm Step = 0.00 mm

Patm/Po = 0.176

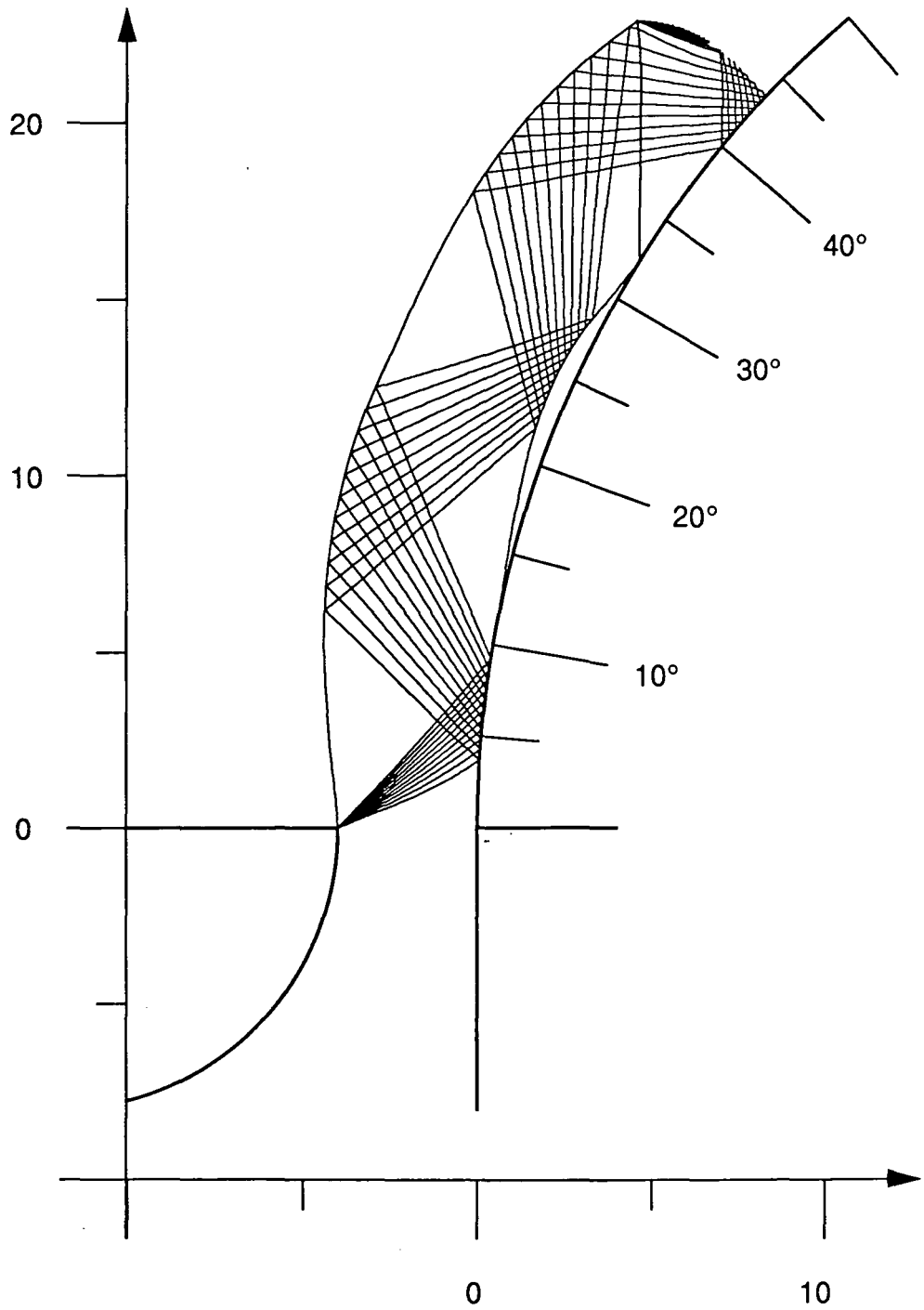


Figure 7.2.22.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 4.00 mm    Step = 0.00 mm

Patm/Po = 0.355



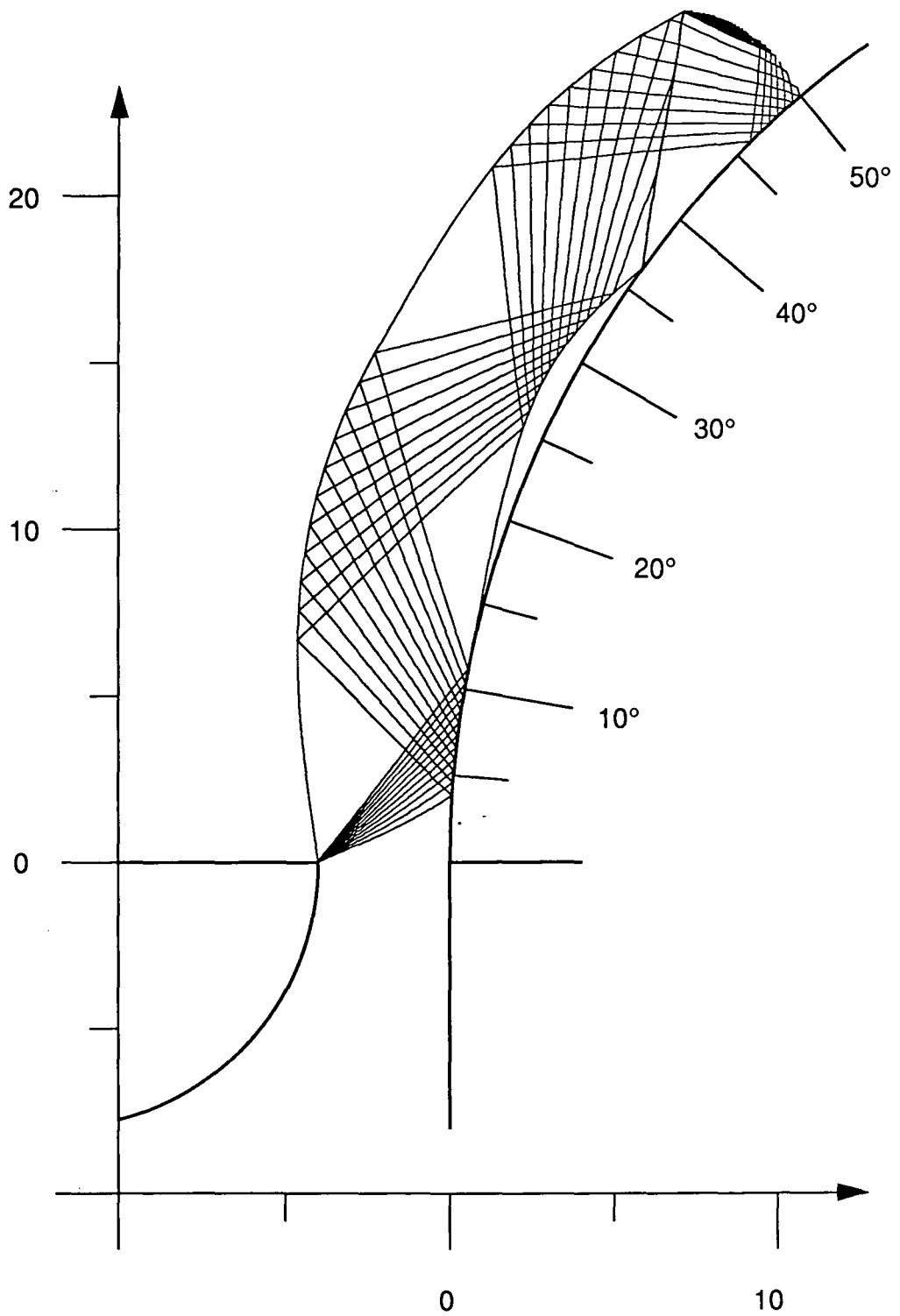


Figure 7.2.23.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 4.00 mm Step = 0.00 mm

Patm/Po = 0.324

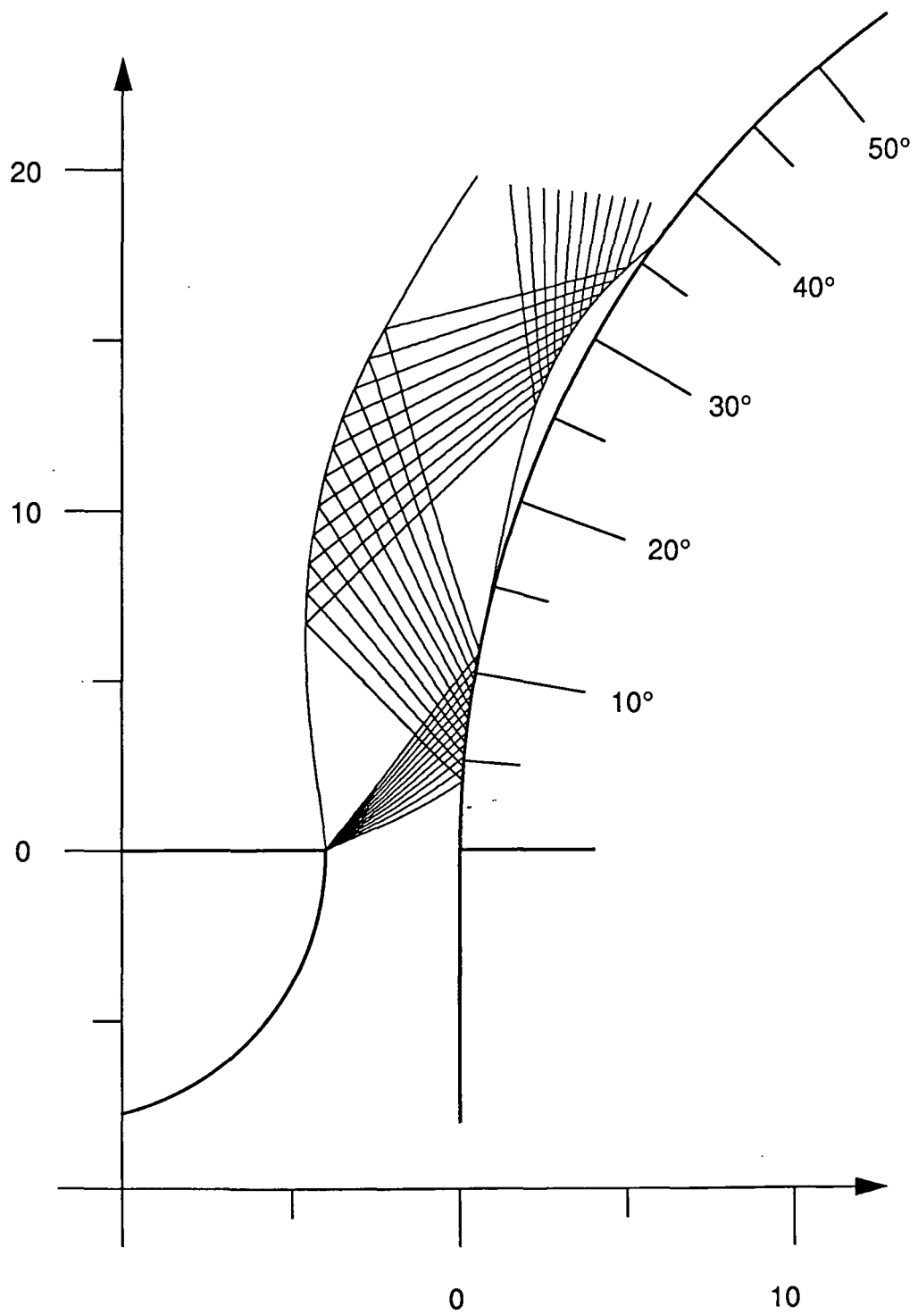


Figure 7.2.24.

Planar Coanda Model  
Method of Characteristics Plot  
 Separation Model  
 Slot = 4.00 mm    Step = 0.00 mm  
 Patm/Po = 0.324

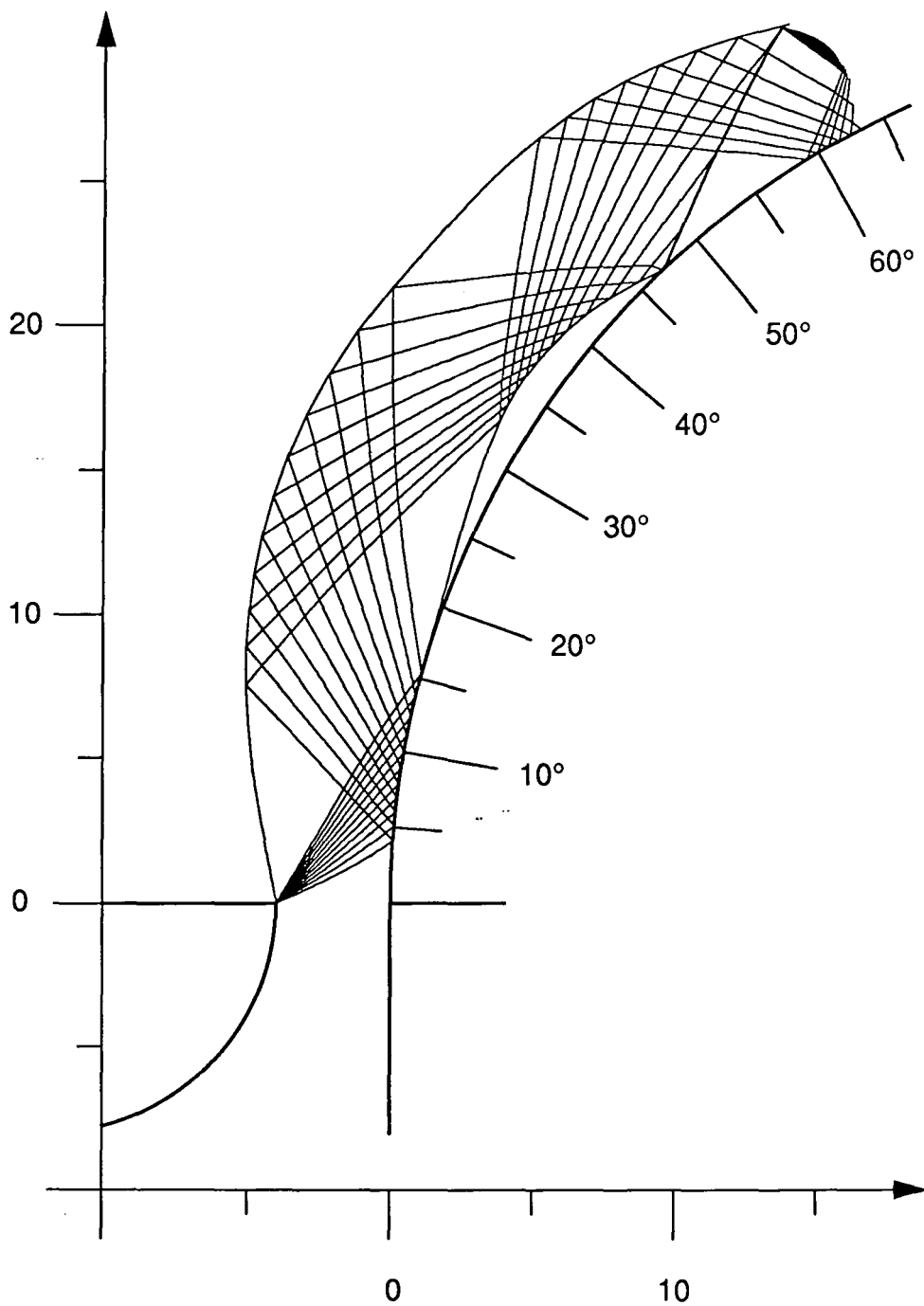


Figure 7.2.25.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 4.00 mm Step = 0.00 mm

Patm/Po = 0.277

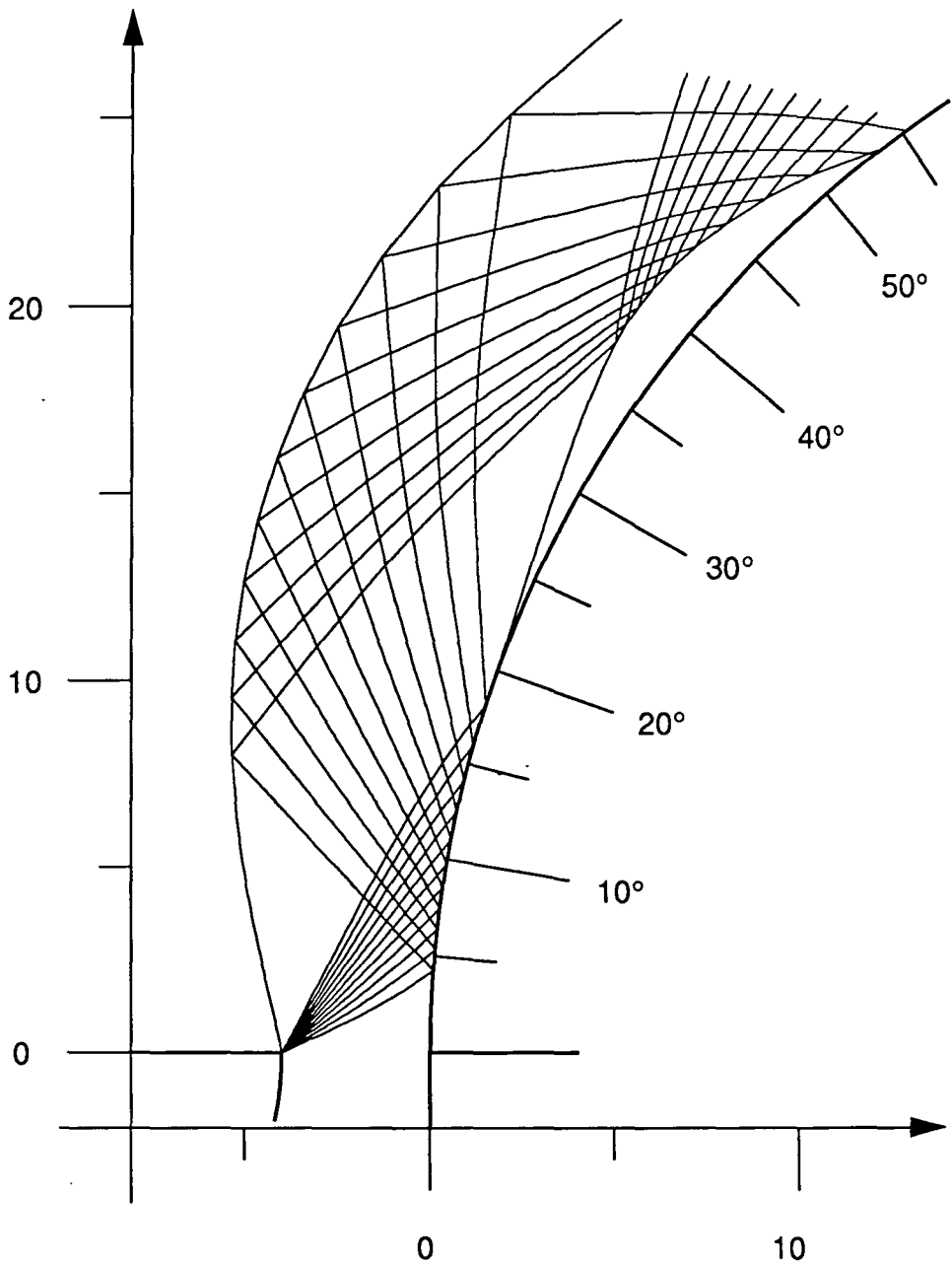


Figure 7.2.26.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 4.00 mm    Step = 0.00 mm

Patm/Po = 0.256

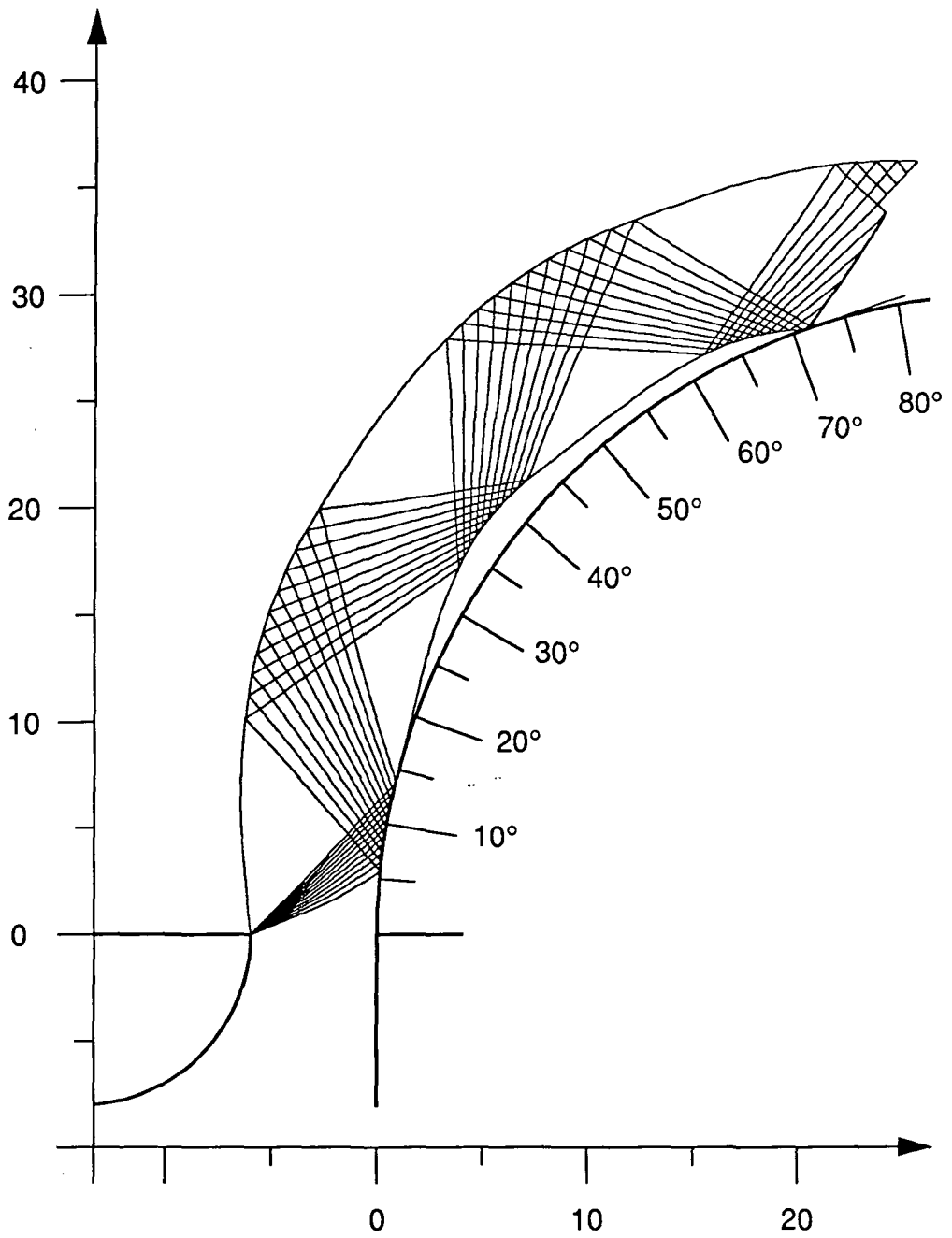


Figure 7.2.27.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 6.00 mm Step = 0.00 mm

Patm/Po = 0.366

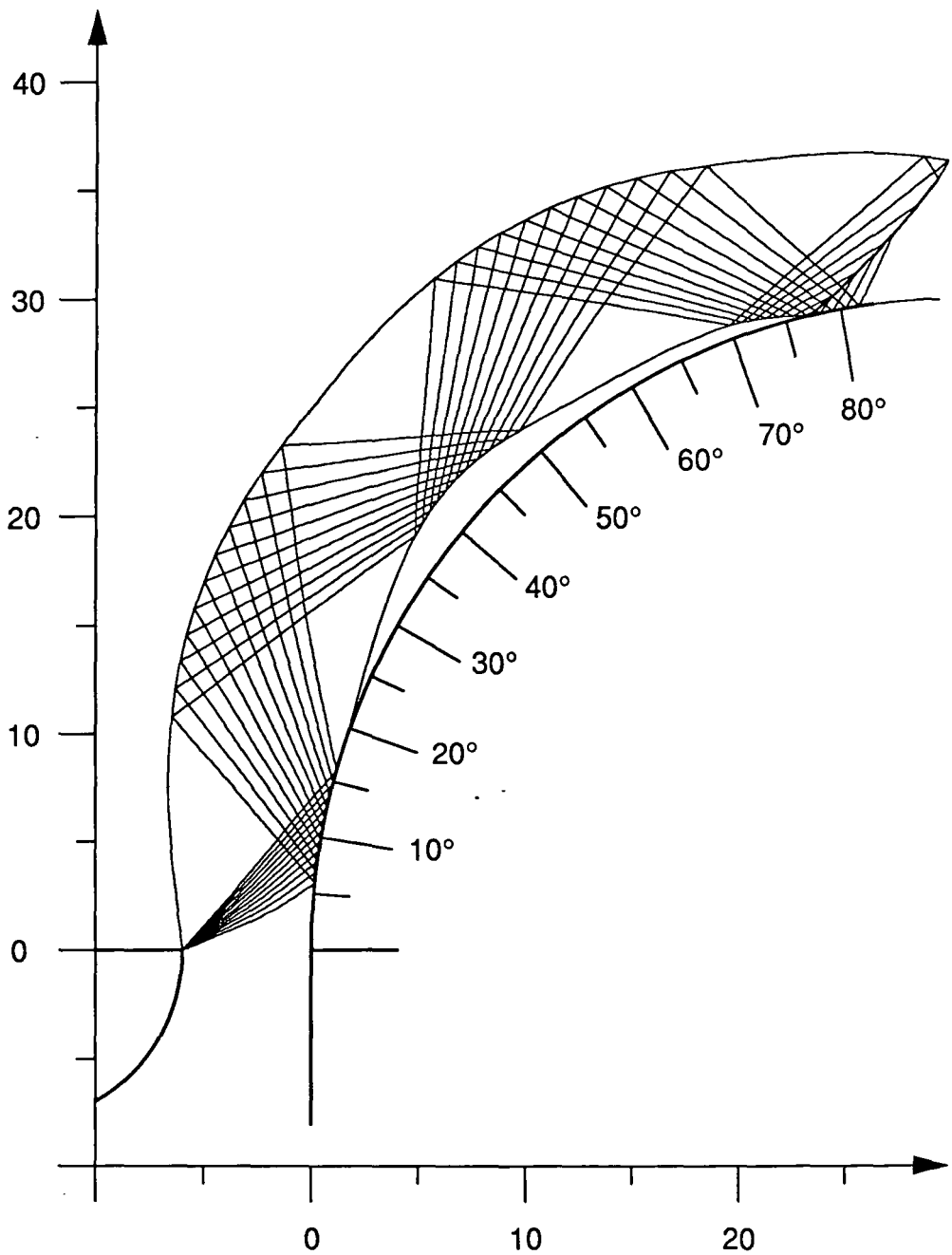


Figure 7.2.28. Planar Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Slot = 6.00 mm    Step = 0.00 mm  
 $P_{atm}/P_o = 0.343$

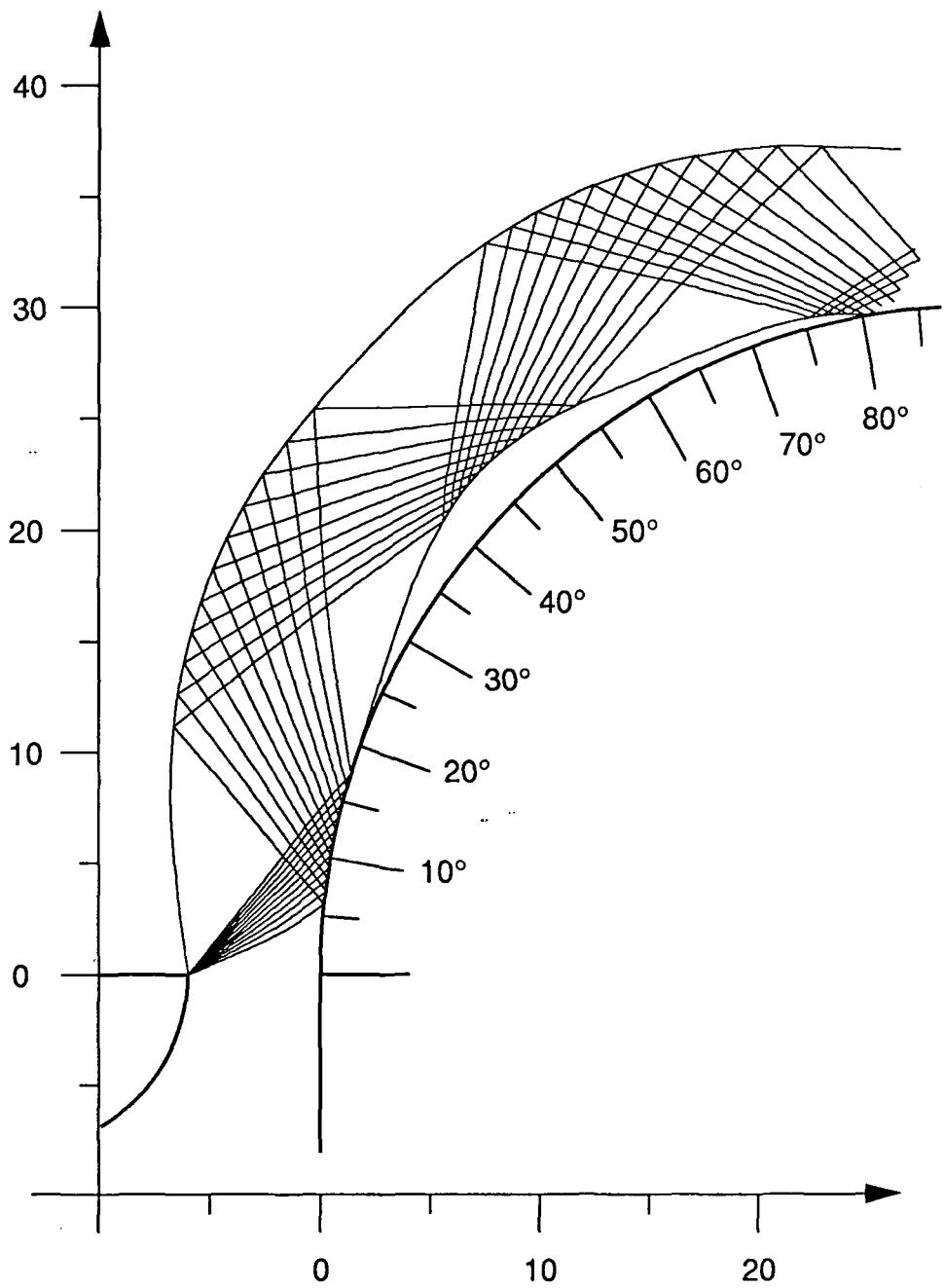


Figure 7.2.29.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 6.00 mm Step = 0.00 mm

Patm/Po = 0.330

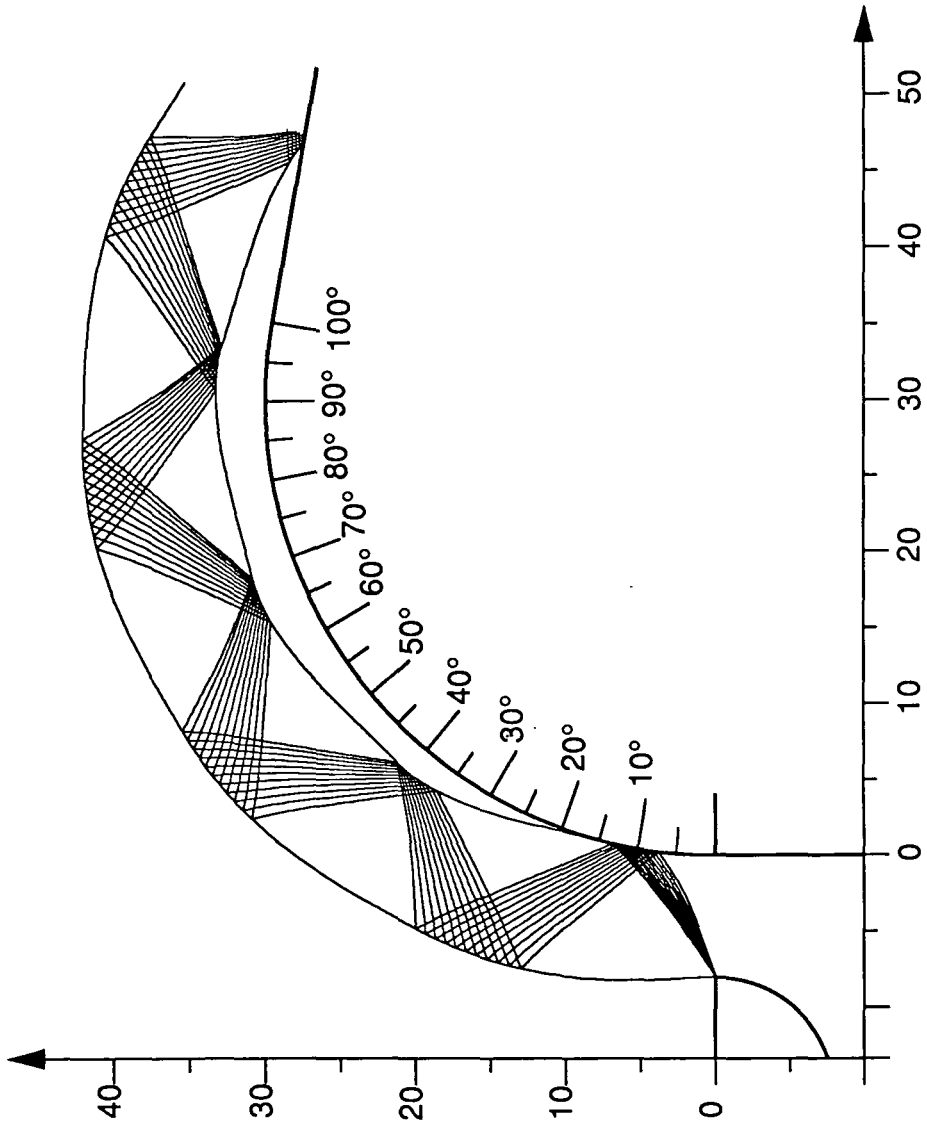


Figure 7.2.30.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 8.00 mm Step = 0.00 mm

Patm/Po = 0.425



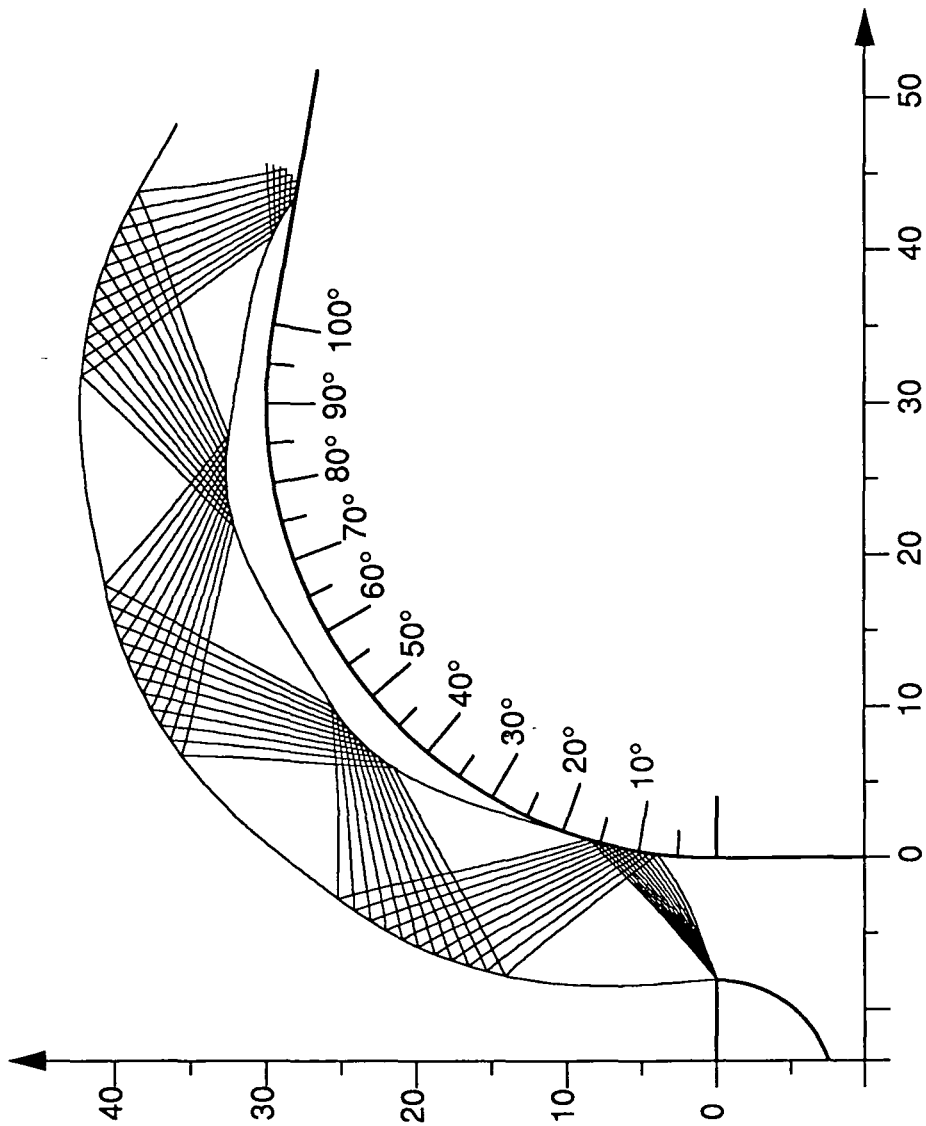


Figure 7.2.31.

Planar Coanda Model

Method of Characteristics Plot

Shock Fitting; Separation Model

Slot = 8.00 mm Step = 0.00 mm

Patm/Po = 0.391

Pressure Ratio  
[ $P_o/P_{atm}$ ]

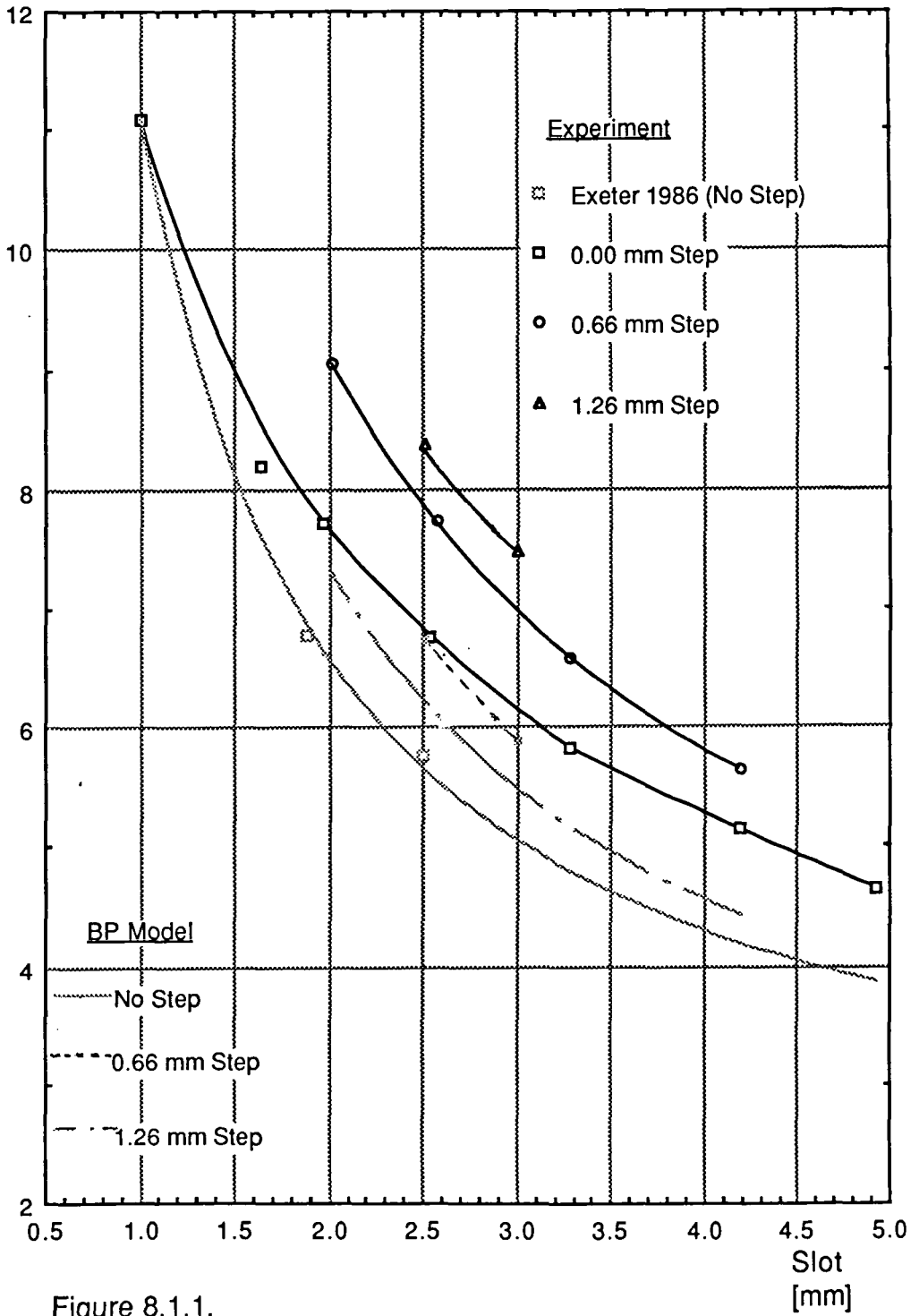


Figure 8.1.1.

Axisymmetric Coanda Model  
Breakaway Performance

Pressure Ratio  
[ $P_o/P_{atm}$ ]

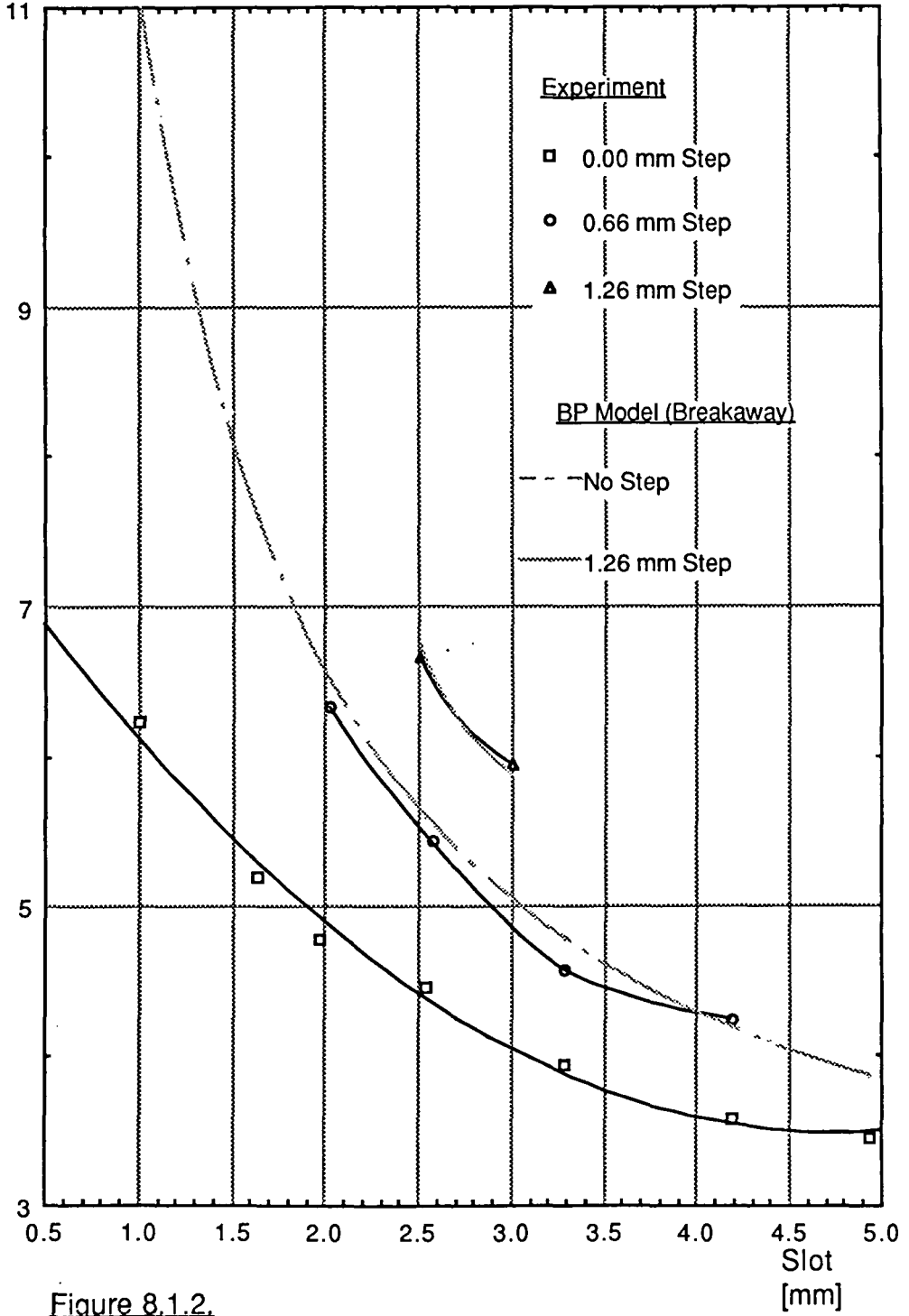


Figure 8.1.2.

Axisymmetric Coanda Model  
Reversion Performance

Pressure Ratio  
[Po/Patm]

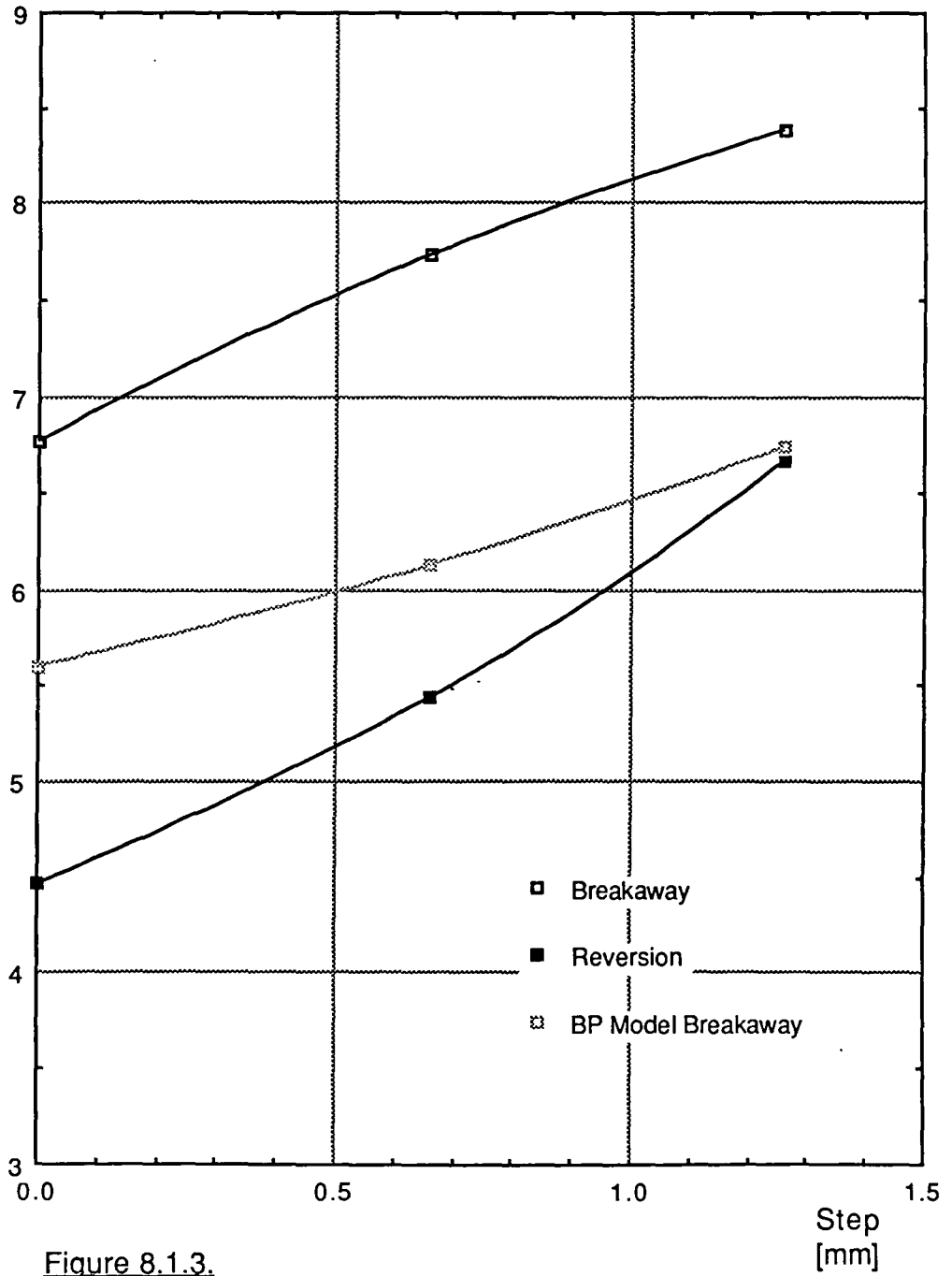


Figure 8.1.3.

Axisymmetric Coanda Model: 2.55mm Slot  
Breakaway/Reversion Behaviour

# PAGE MISSING

Fig. 8.1.3 PLANAR COANDA MODEL  
PARTIAL REVERSION BEHAVIOUR.

—

Fig. 8.1.4

Base Pressure  
[Pa]

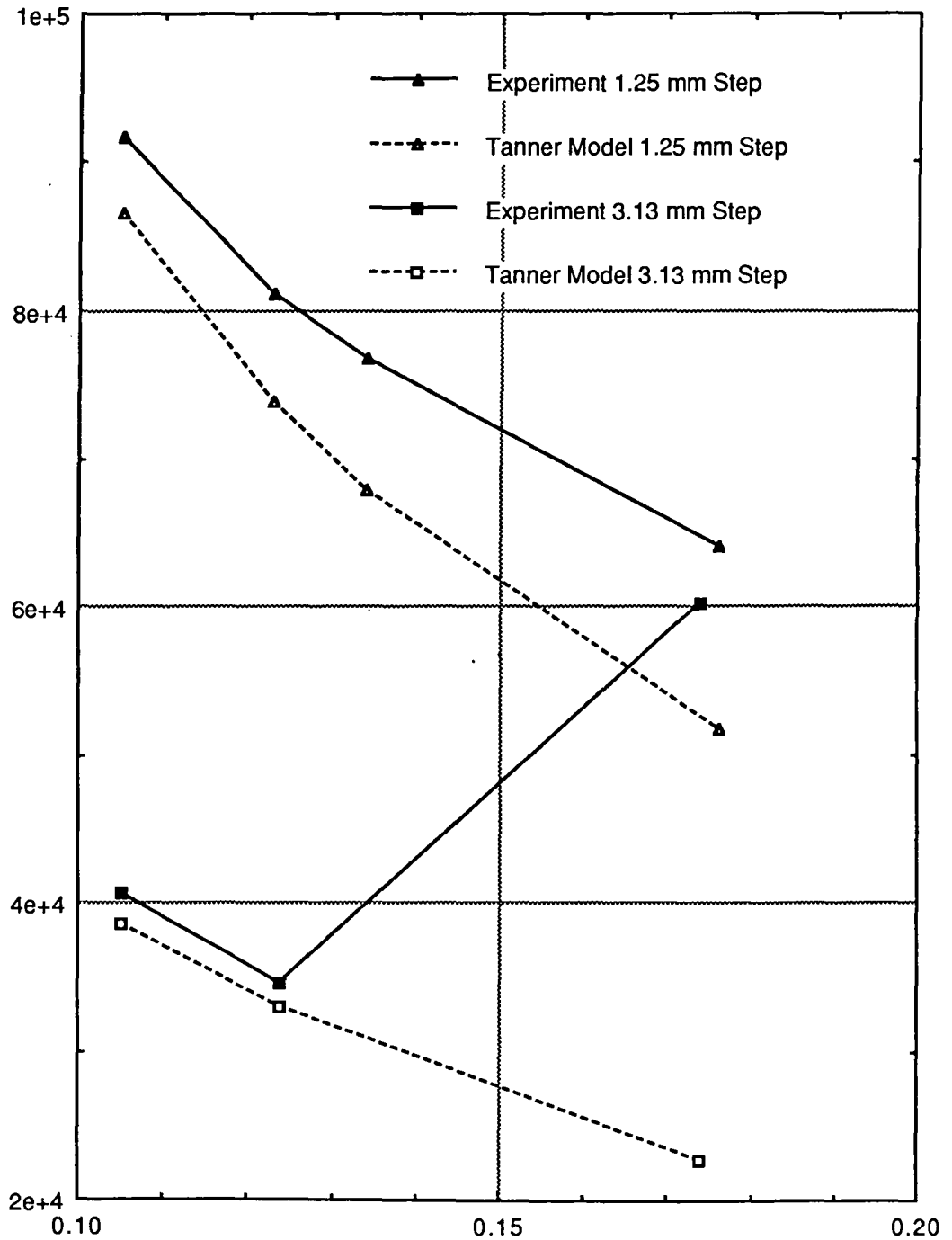


Figure 8.2.1.

Axisymmetric Coanda Model  
Base Pressures: 1.67 mm Slot

Base Pressure  
[Pa]

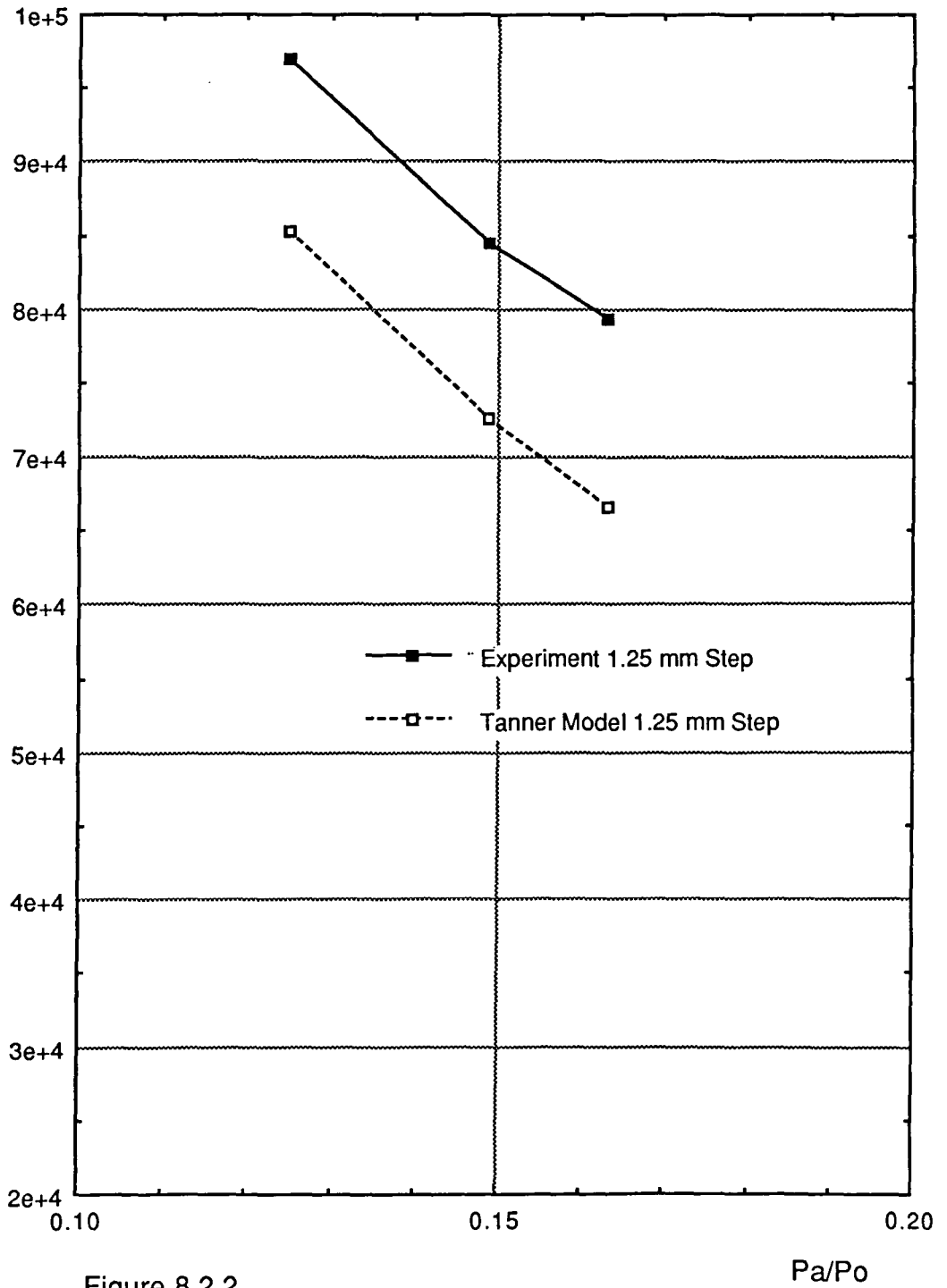


Figure 8.2.2.

Axisymmetric Coanda Model  
Base Pressures: 2.55 mm Slot

Base Pressure  
[Pa]

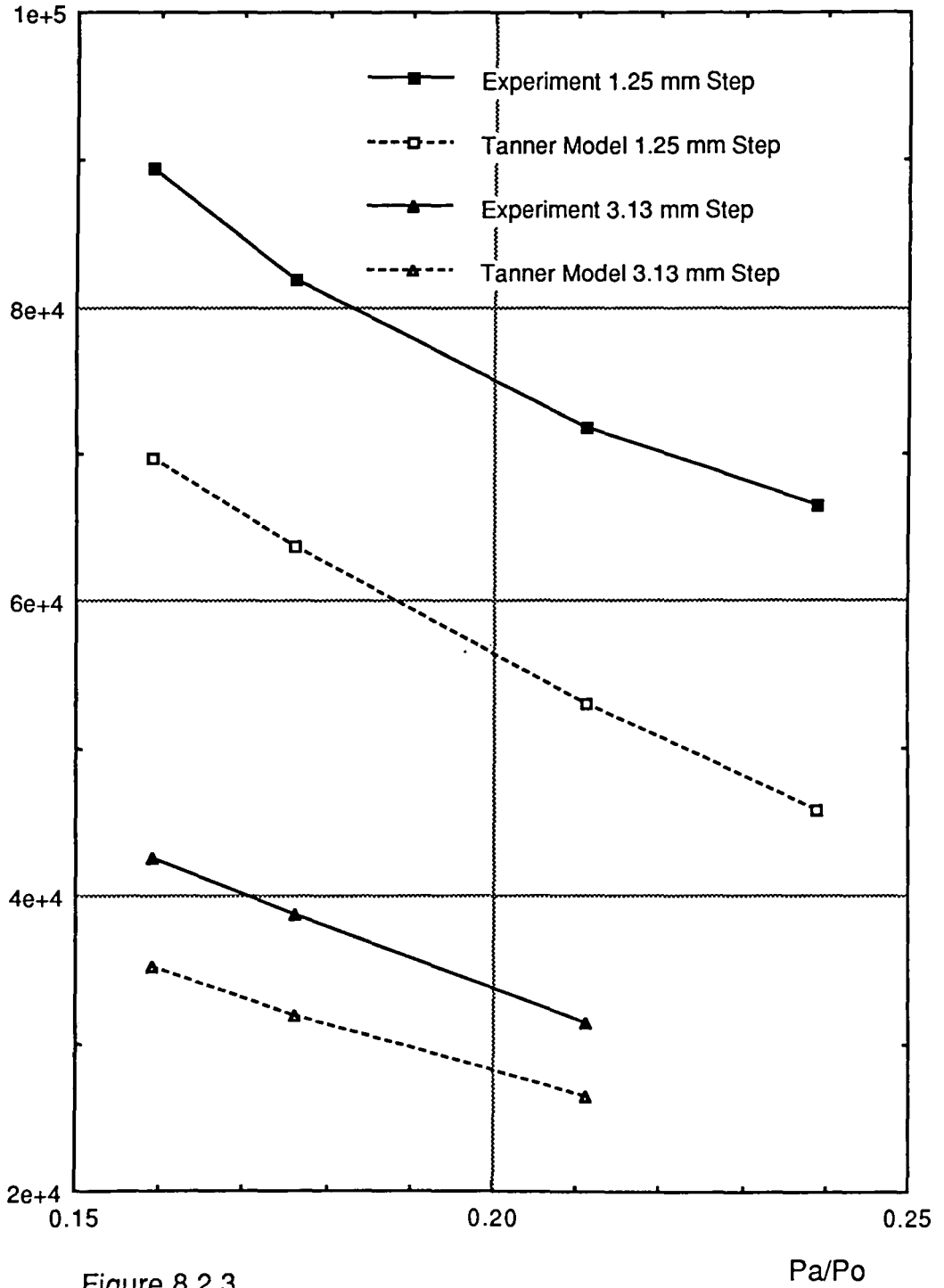


Figure 8.2.3.

Axisymmetric Coanda Model  
Base Pressures: 3.33 mm Slot



Base Pressure  
[Pa]

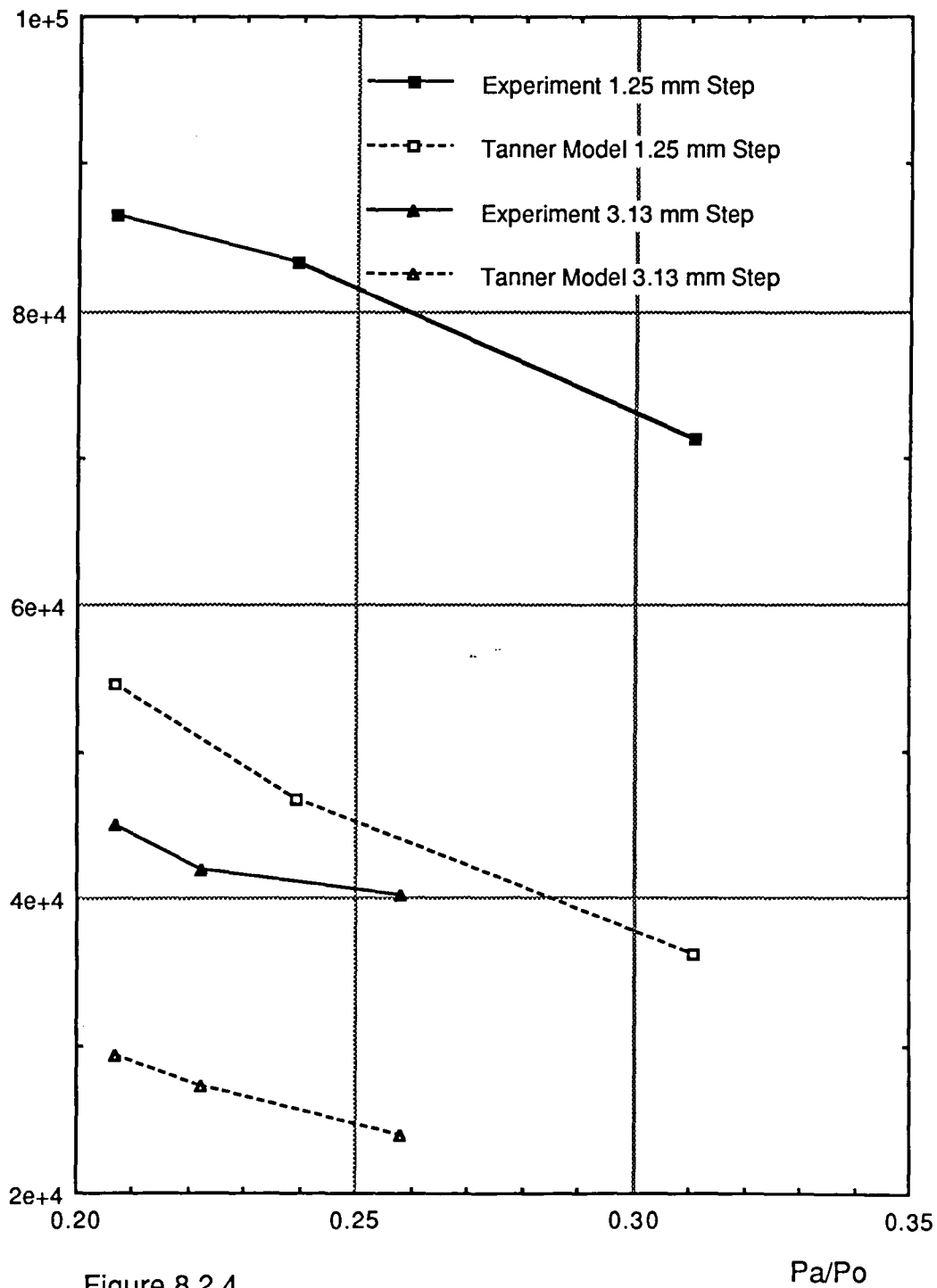


Figure 8.2.4.

Axisymmetric Coanda Model  
Base Pressures: 5.00 mm Slot

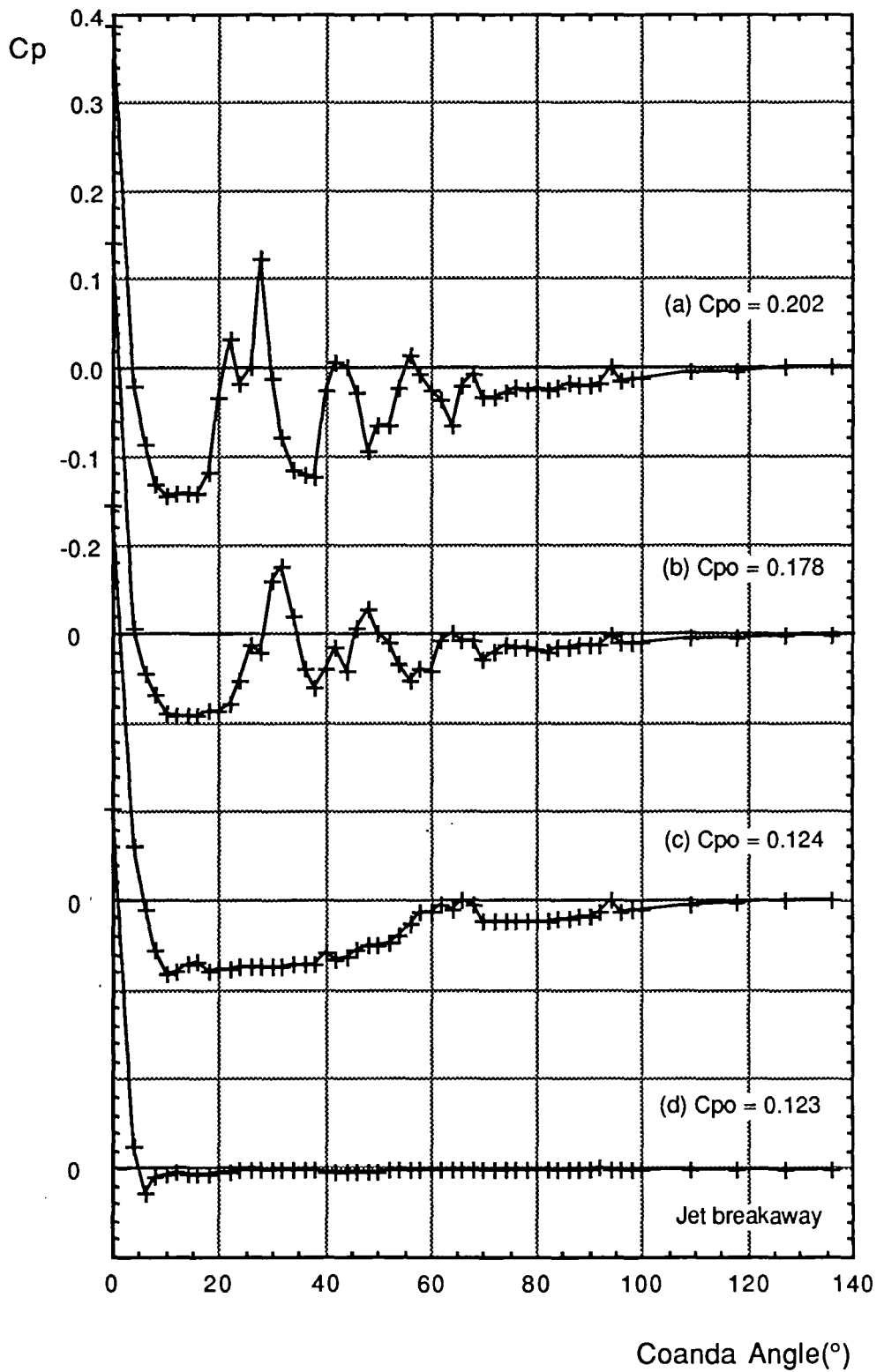


Figure 8.1.5.

Axisymmetric Coanda Model  
 Experimental Surface Pressures

Slot = 1.67 mm; Step = 0.00 mm

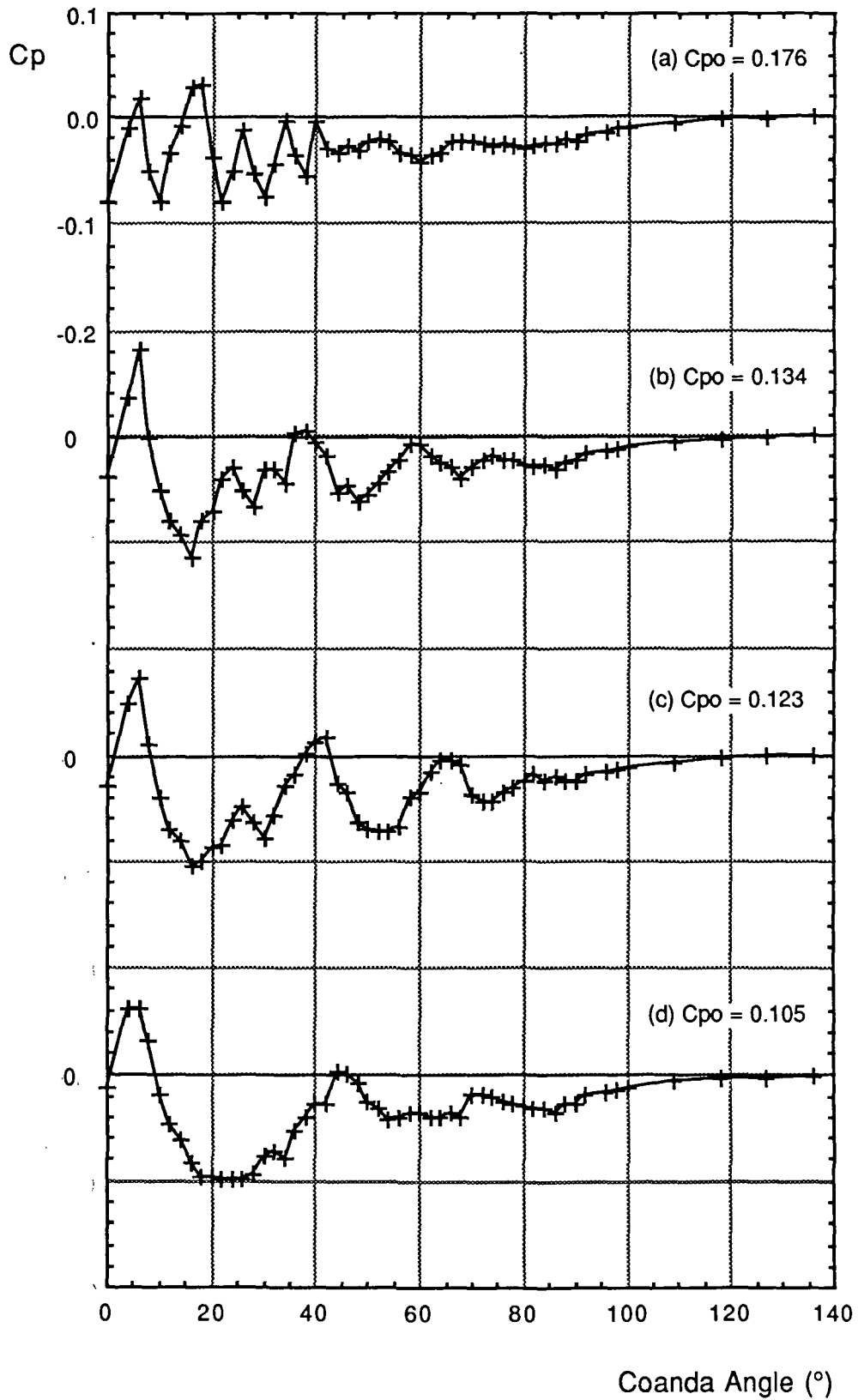


Figure 8.1.6.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 1.67 mm; Step = 1.25 mm

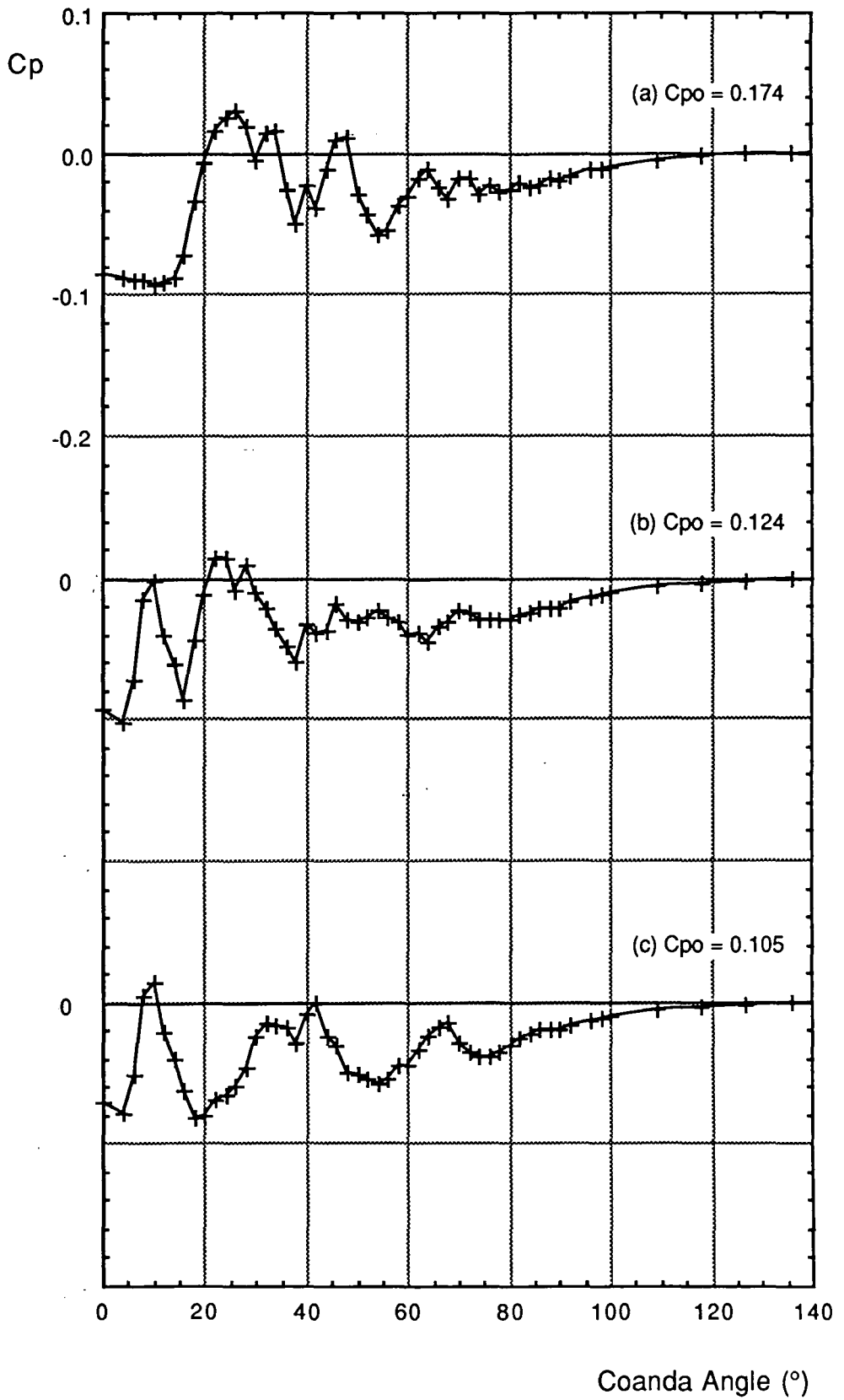


Figure 8.1.7.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 1.67 mm; Step = 3.13 mm

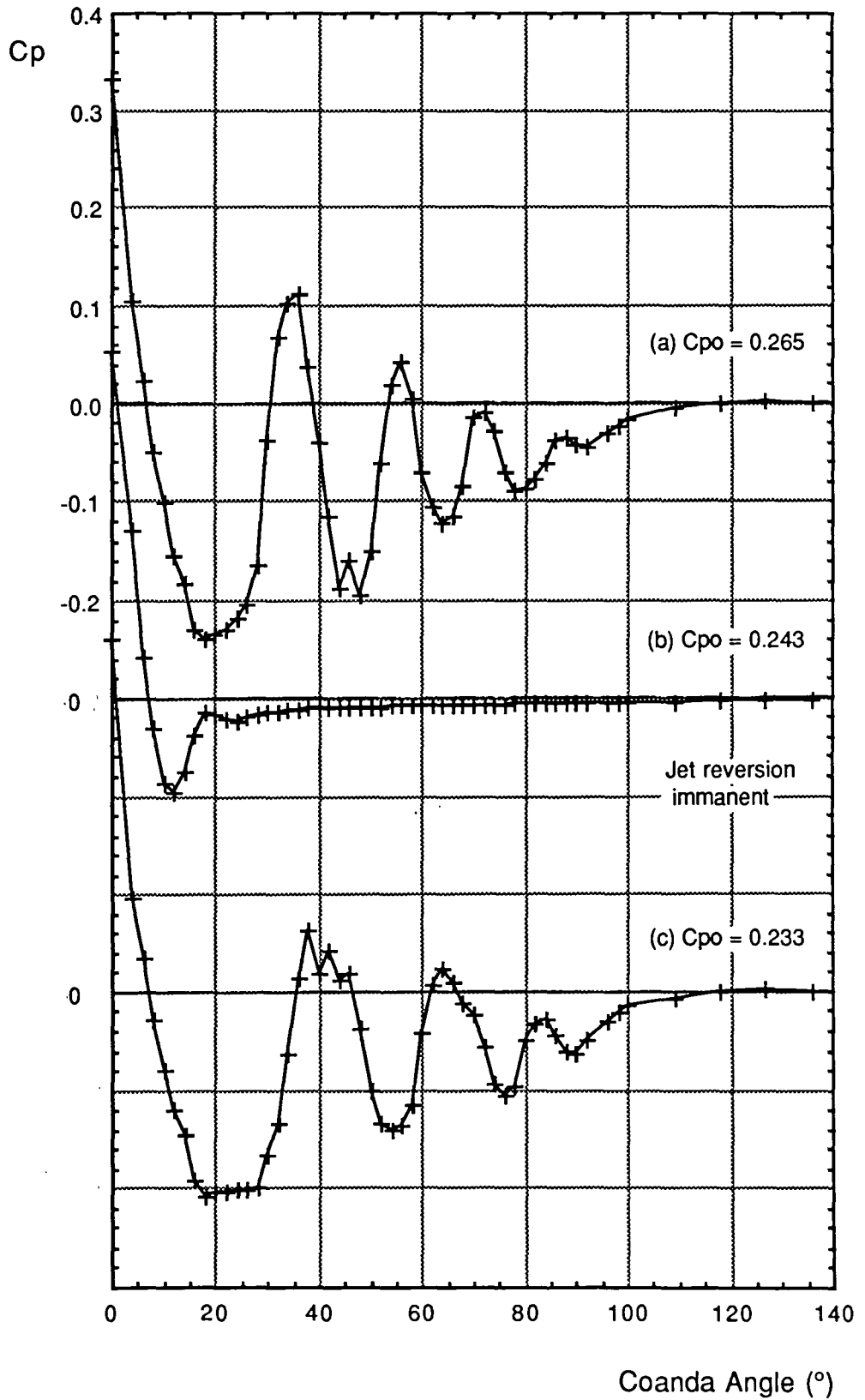


Figure 8.1.8.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 3.33 mm; Step = 0.00 mm

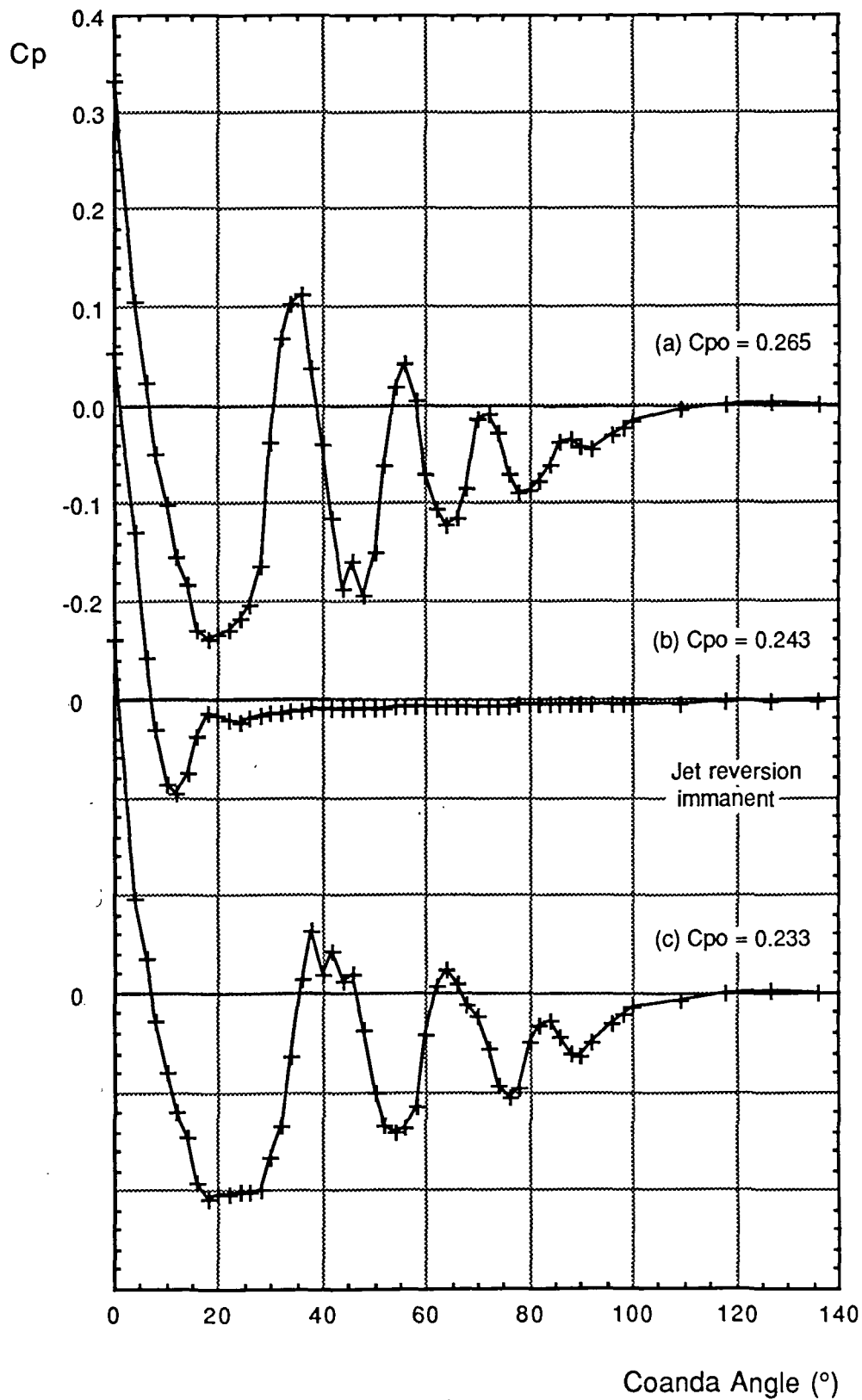


Figure 8.1.8.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 3.33 mm; Step = 0.00 mm

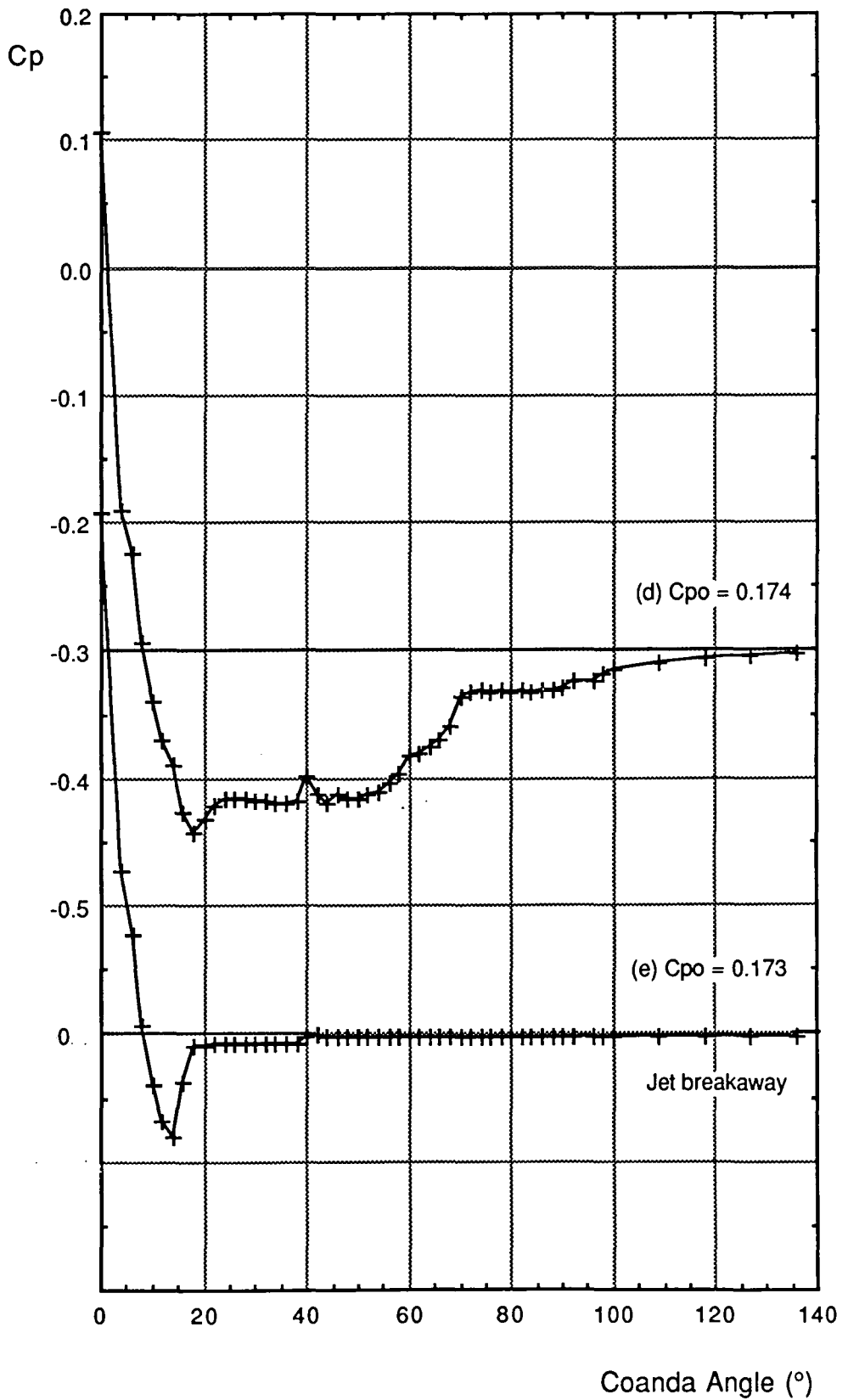


Figure 8.1.9.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 3.33 mm; Step = 0.00 mm

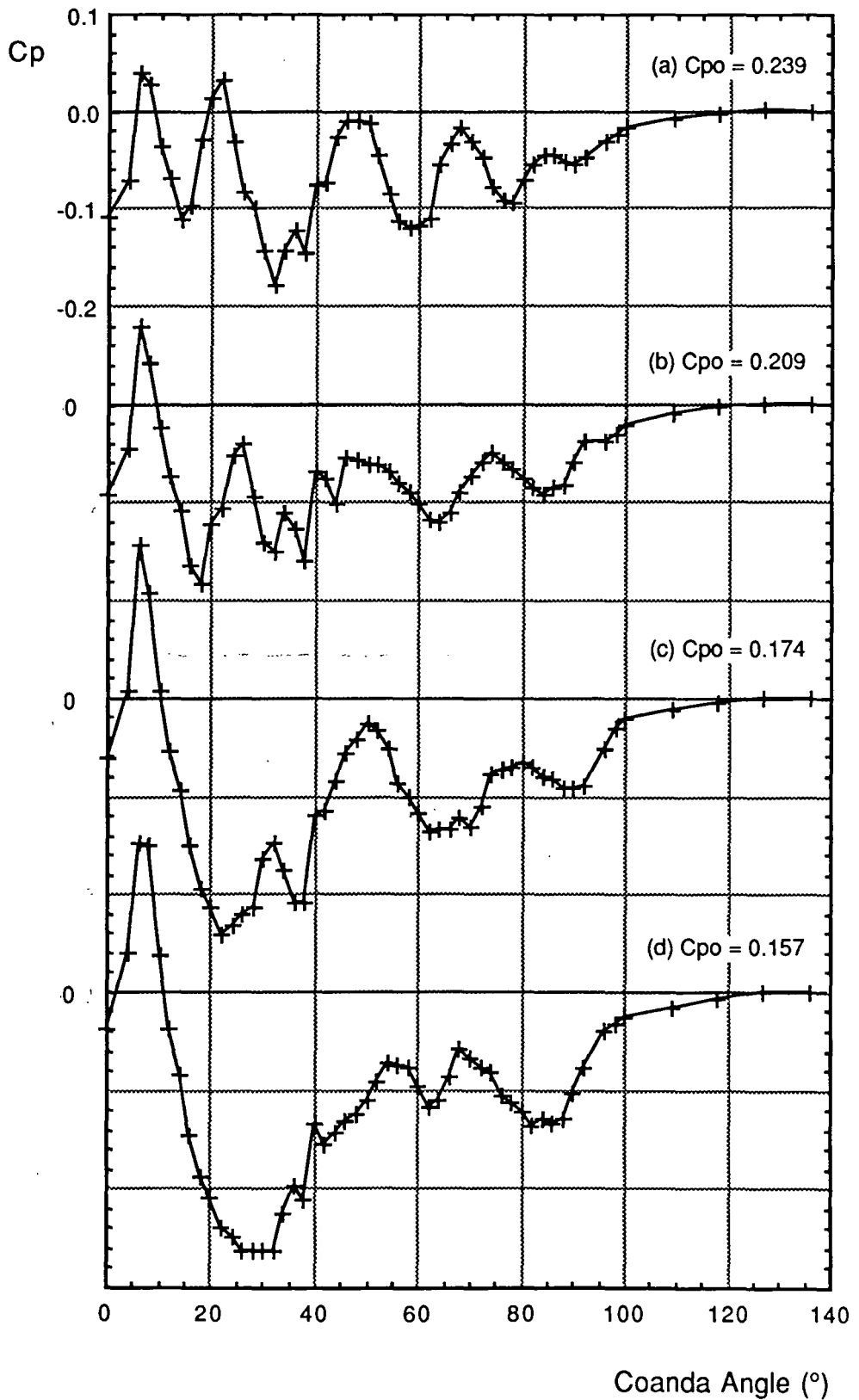


Figure 8.1.10.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 3.33 mm; Step = 1.25 mm



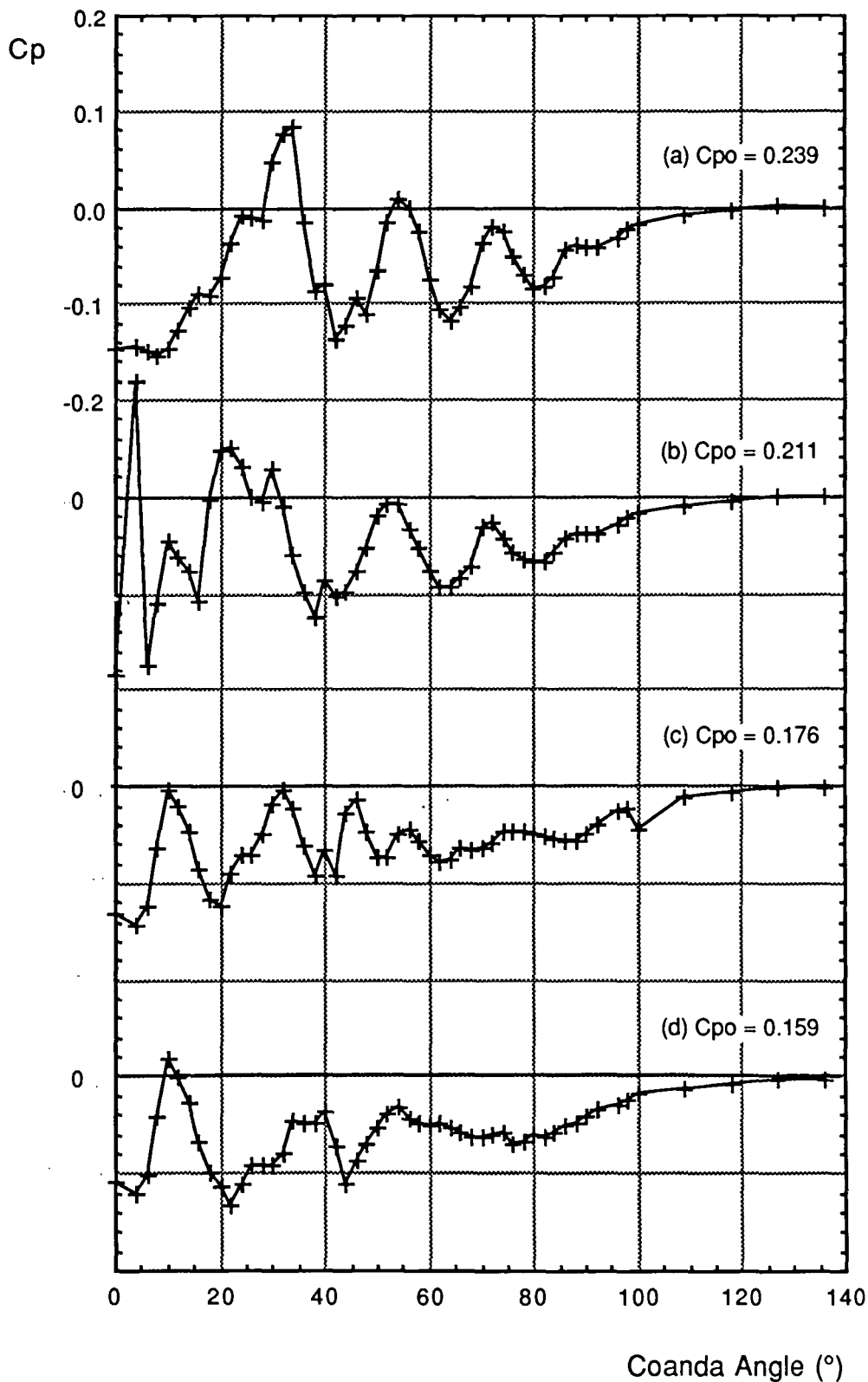


Figure 8.1.11.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 3.33 mm; Step = 3.13 mm

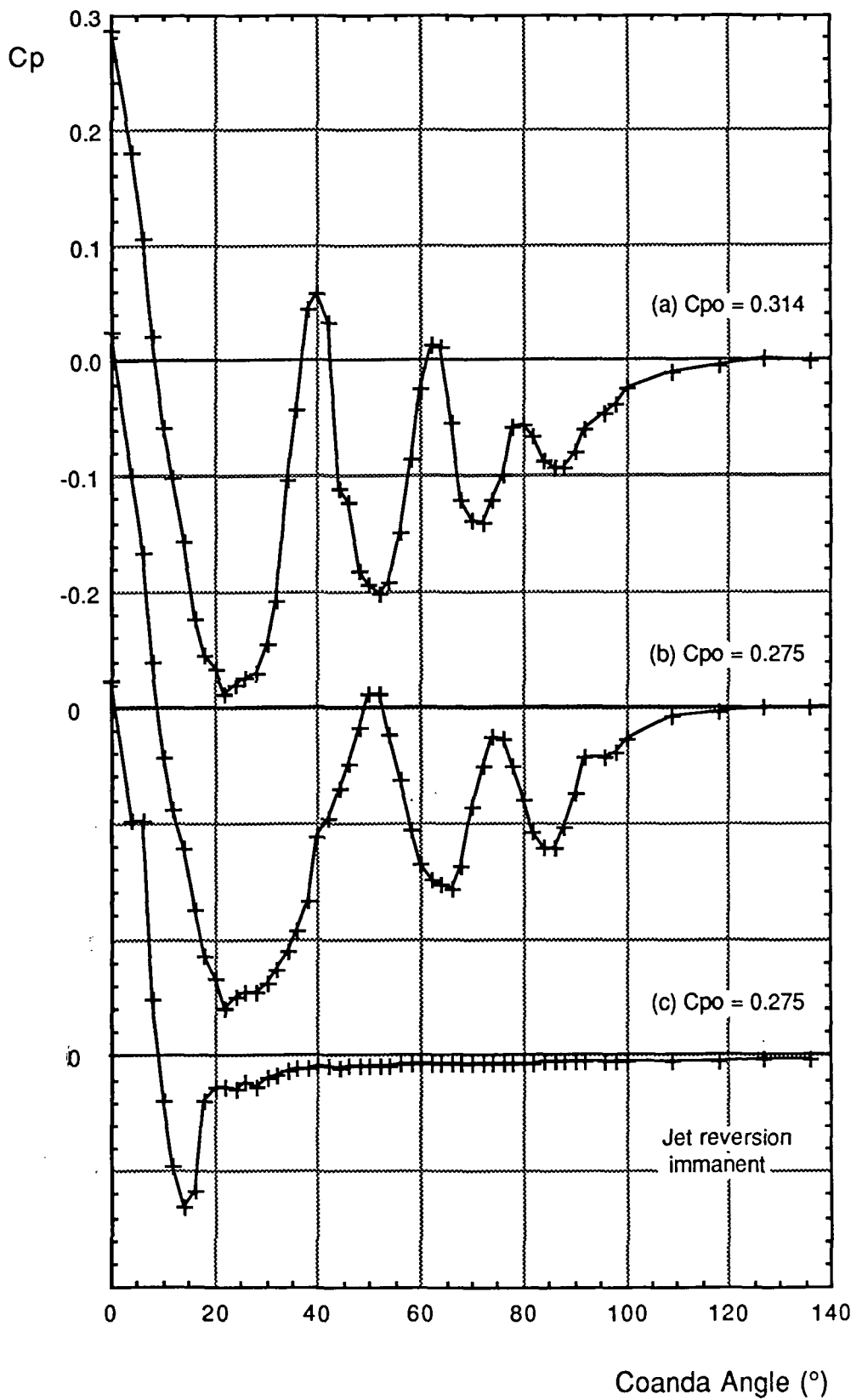


Figure 8.1.12.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 5.00 mm; Step = 0.00 mm

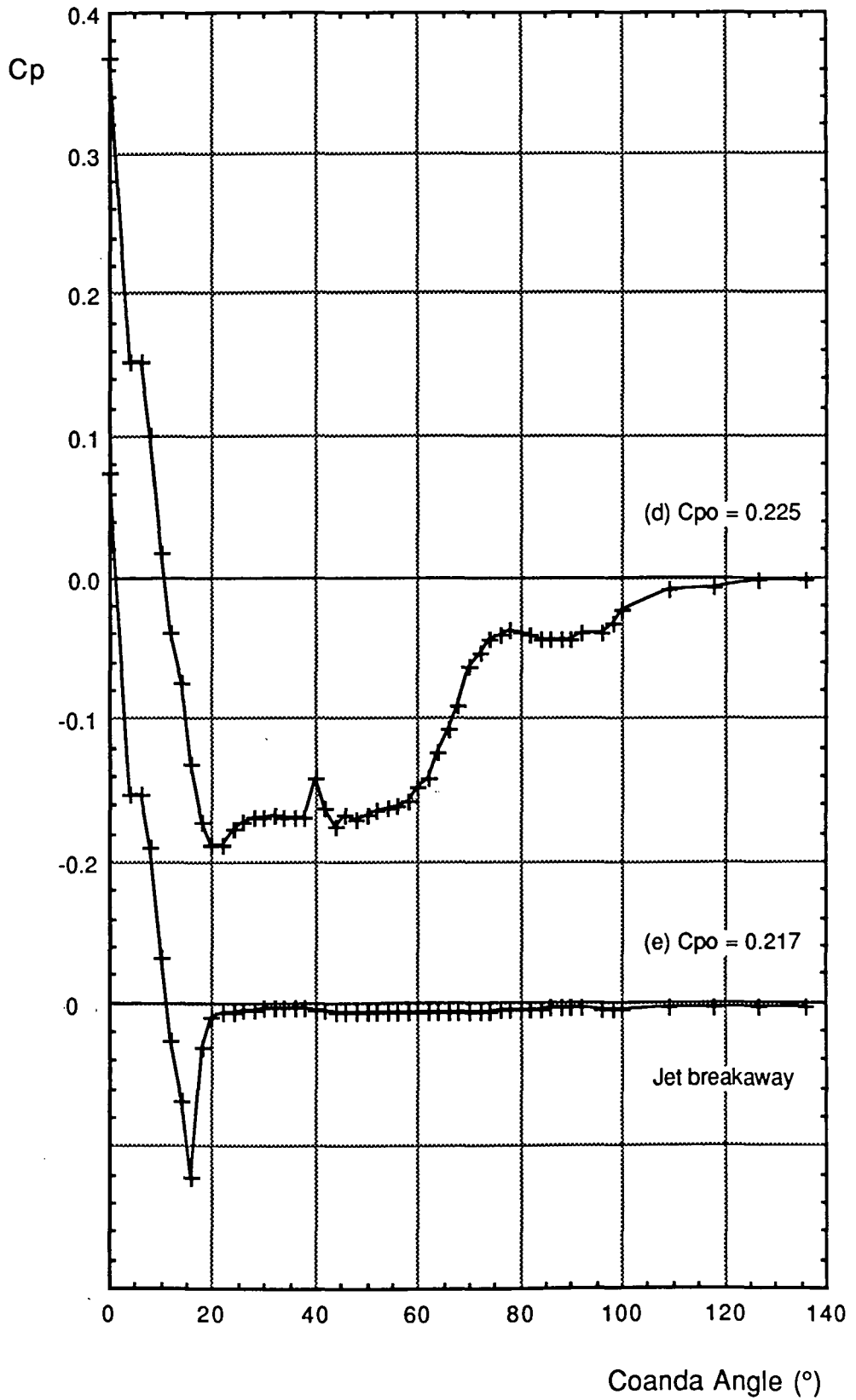


Figure 8.1.13.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 5.00 mm; Step = 0.00 mm

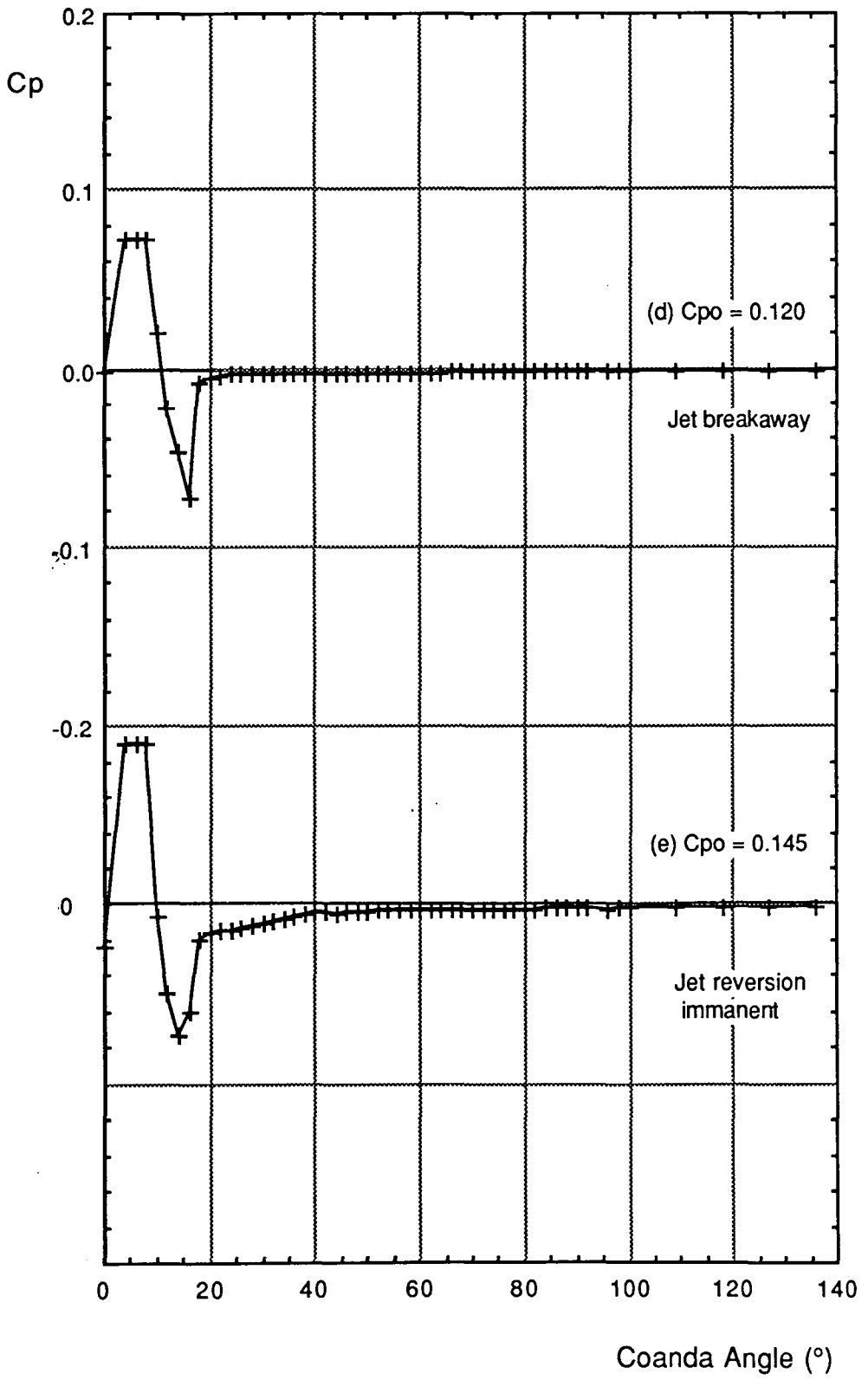
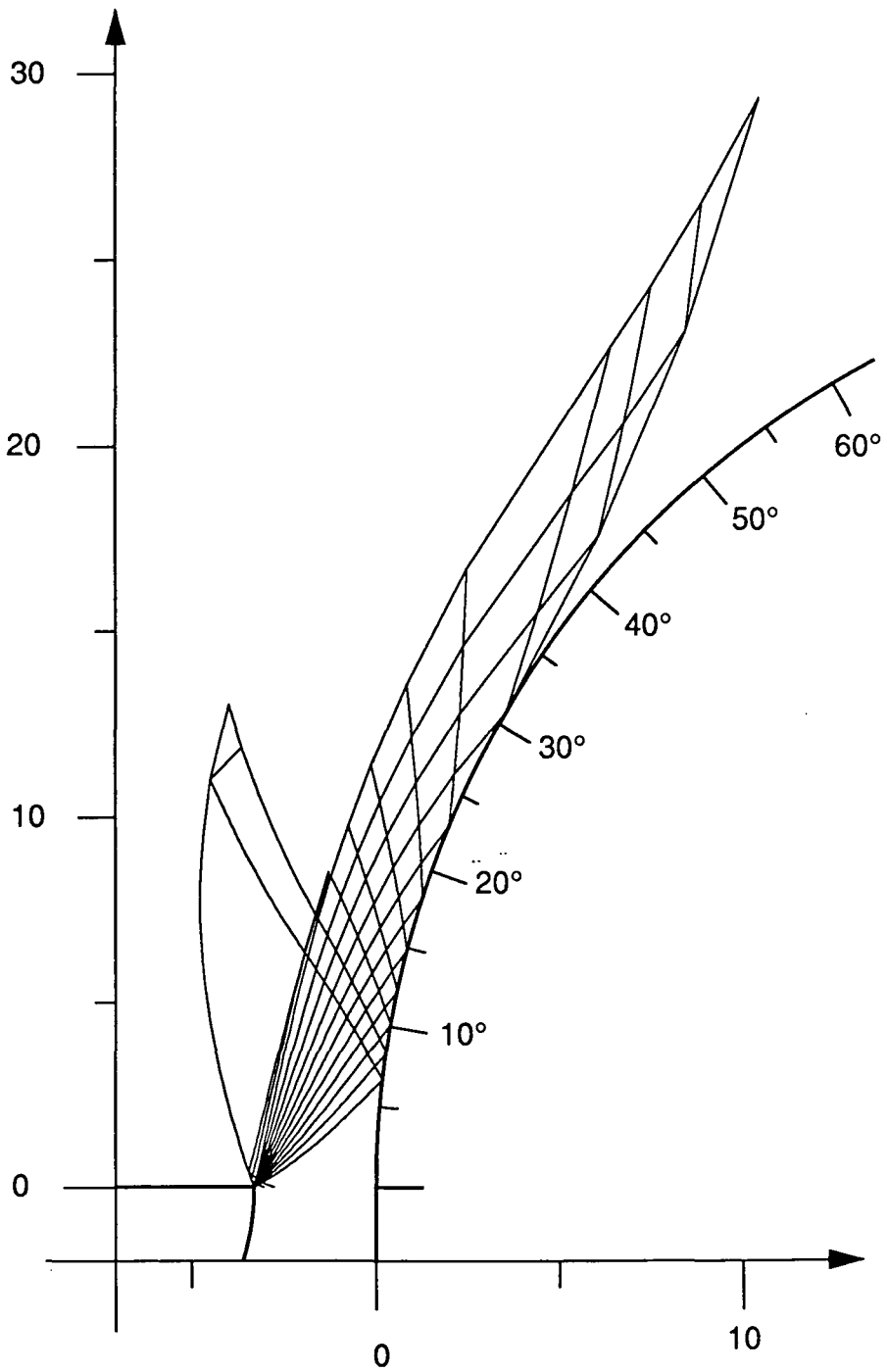


Figure 8.1.17.

Axisymmetric Coanda Model  
Experimental Surface Pressures

Slot = 2.54 mm; Step = 1.25 mm



**Figure 8.2.5.** Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting  
 Slot = 3.33 mm    Step = 0.00 mm  
 $P_{atm}/P_o = 0.174$

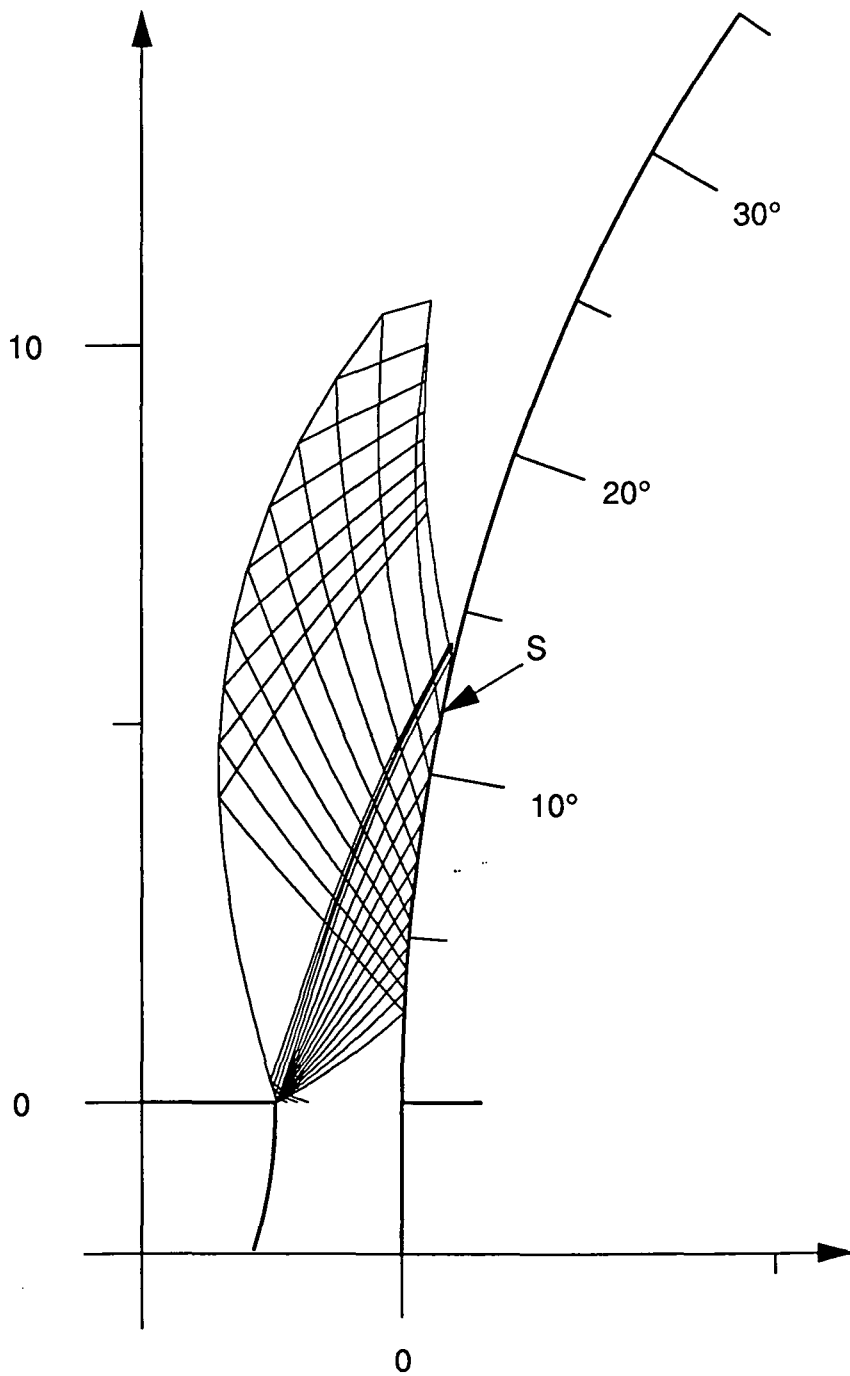


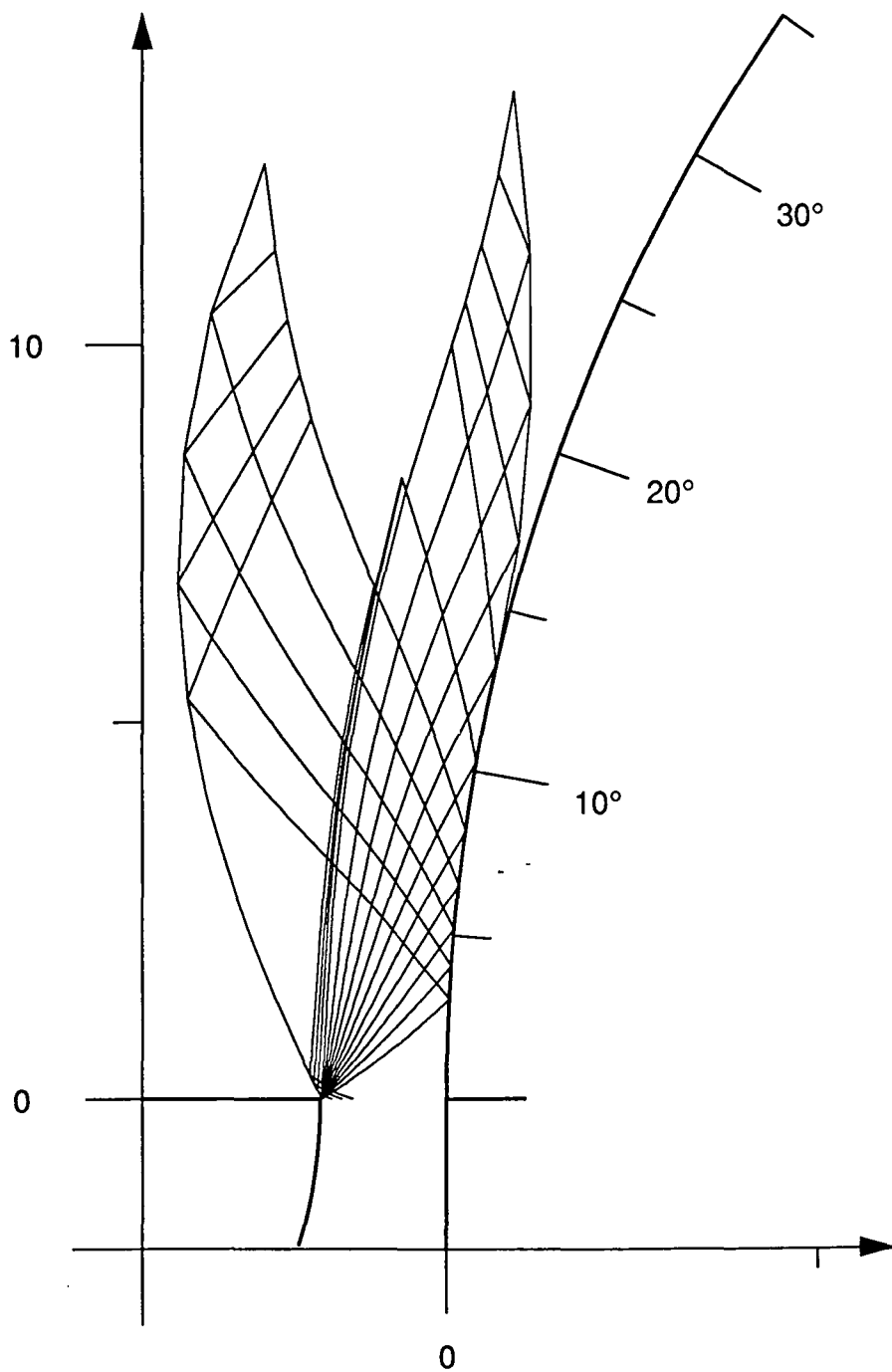
Figure 8.2.6.

Axisymmetric Coanda Model  
Method of Characteristics Plot

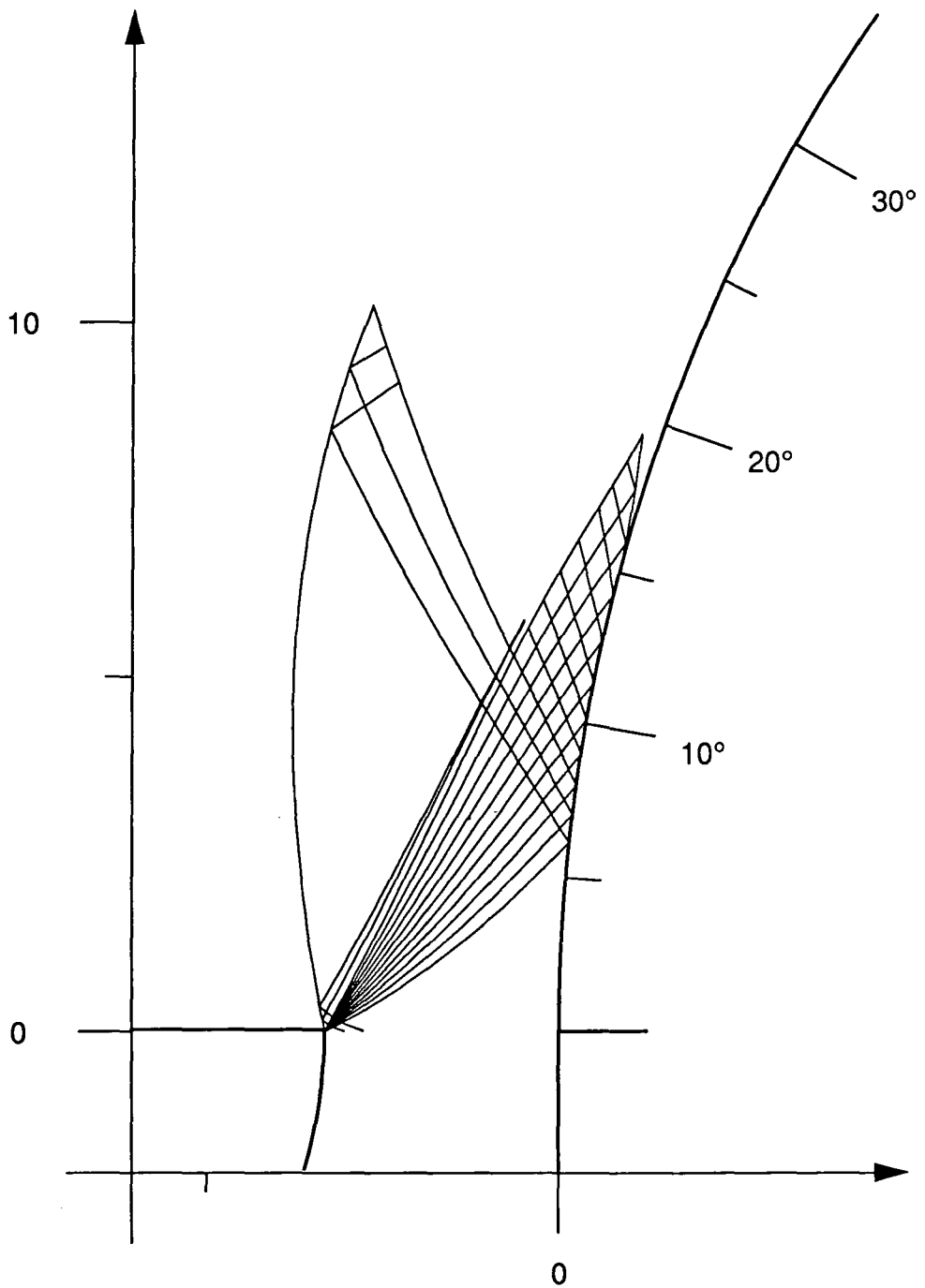
Shock Fitting; Separation Model

Slot = 1.67 mm Step = 0.00 mm

Patm/Po = 0.202



**Figure 8.2.7.** Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Slot = 1.67 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.124$



**Figure 8.2.8.** Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Slot = 3.33 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.265$



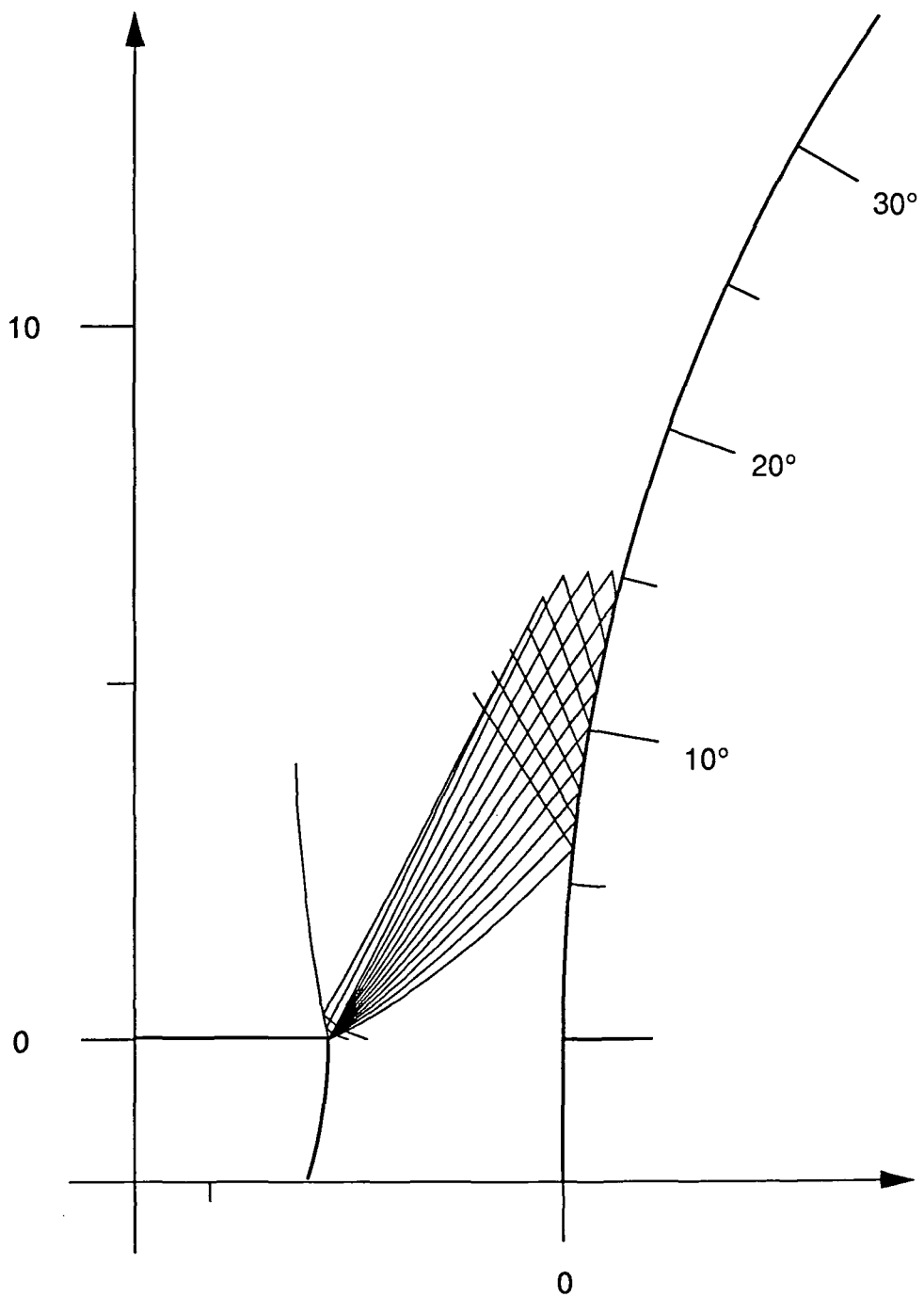


Figure 8.2.9. Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Separation Model  
 Slot = 3.33 mm    Step = 0.00 mm  
 $P_{atm}/P_o = 0.265$

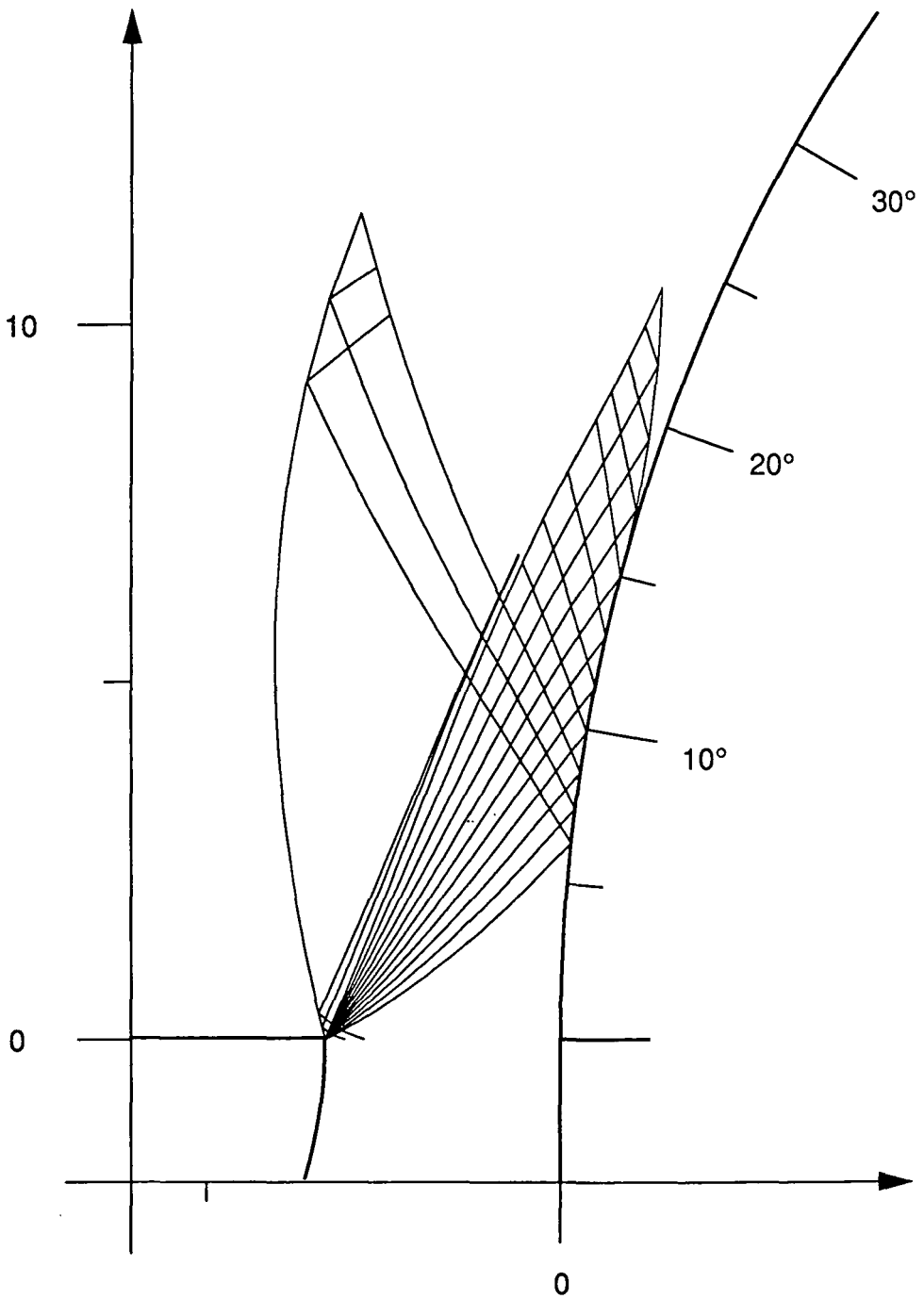
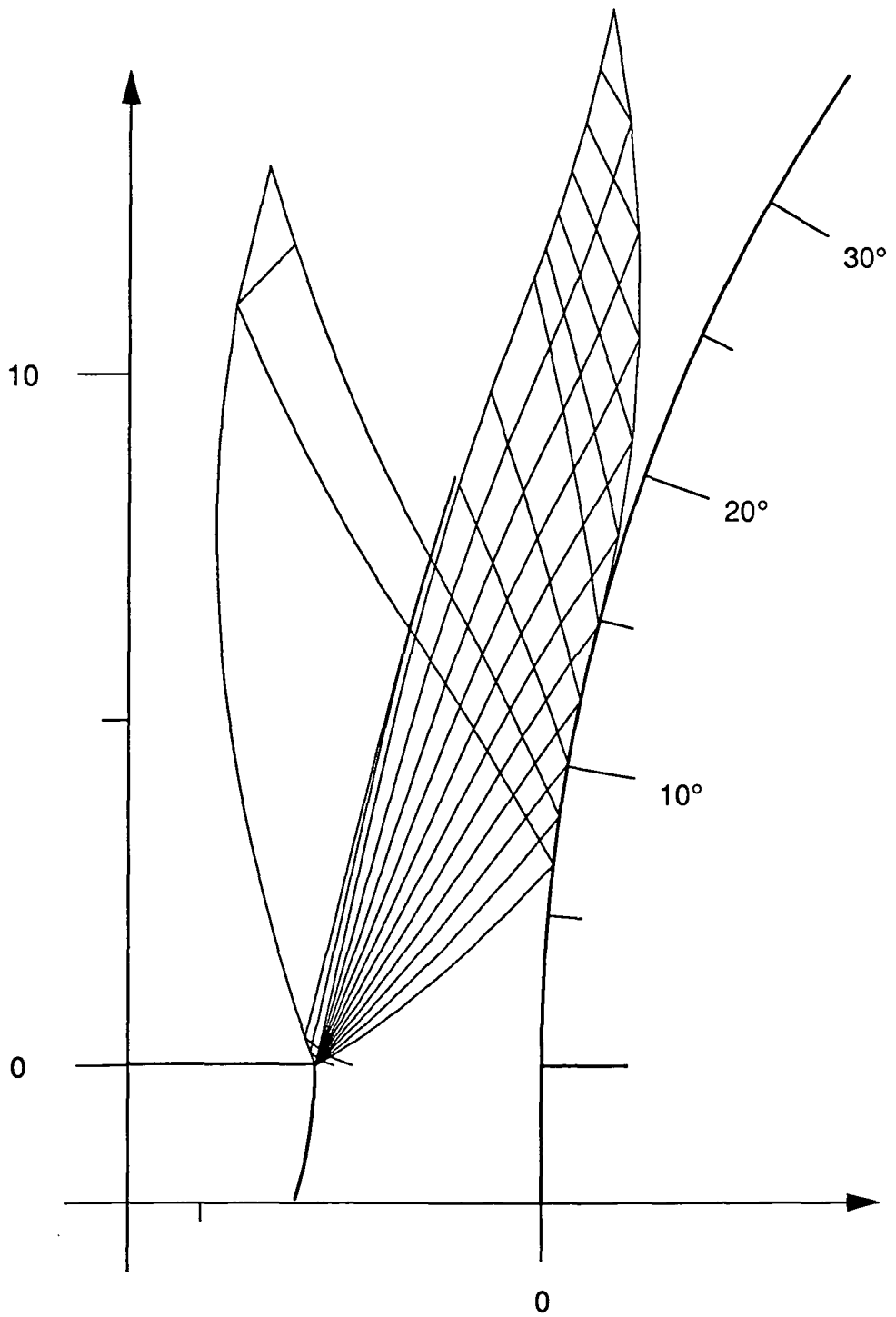


Figure 8.2.10. Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Slot = 3.33 mm Step = 0.00 mm  
 Patm/Po = 0.233



**Figure 8.2.11.** Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Slot = 3.33 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.174$

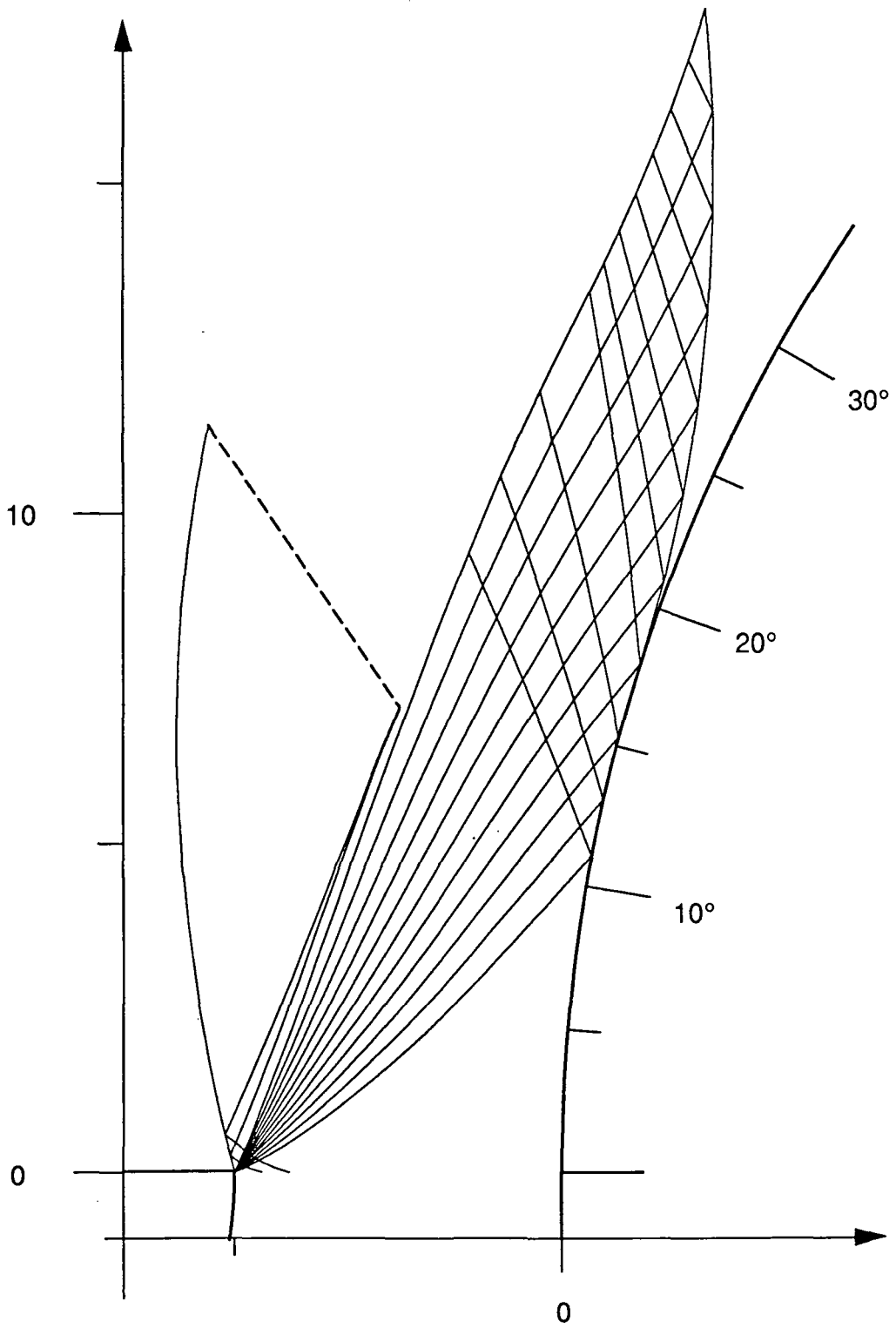
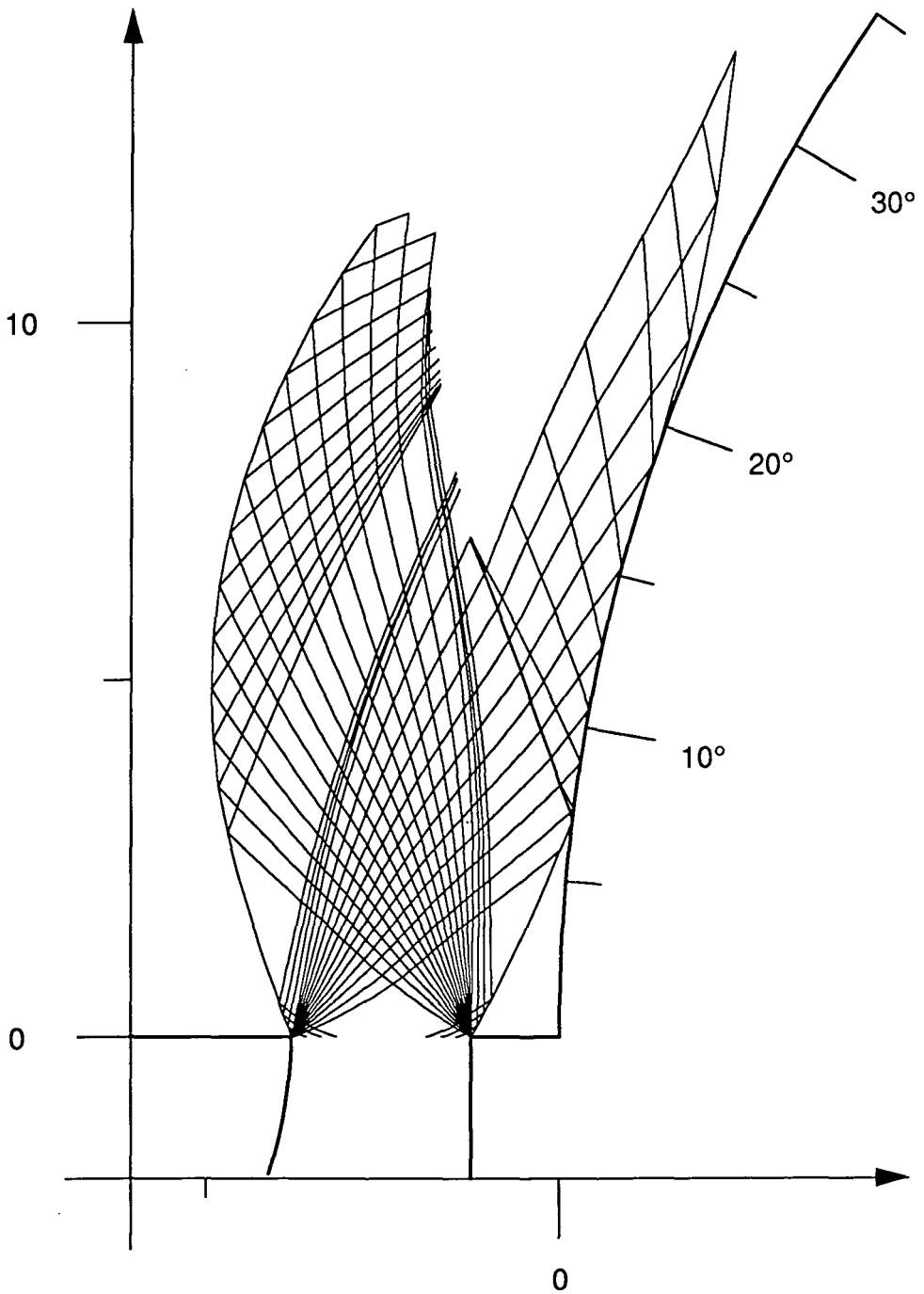
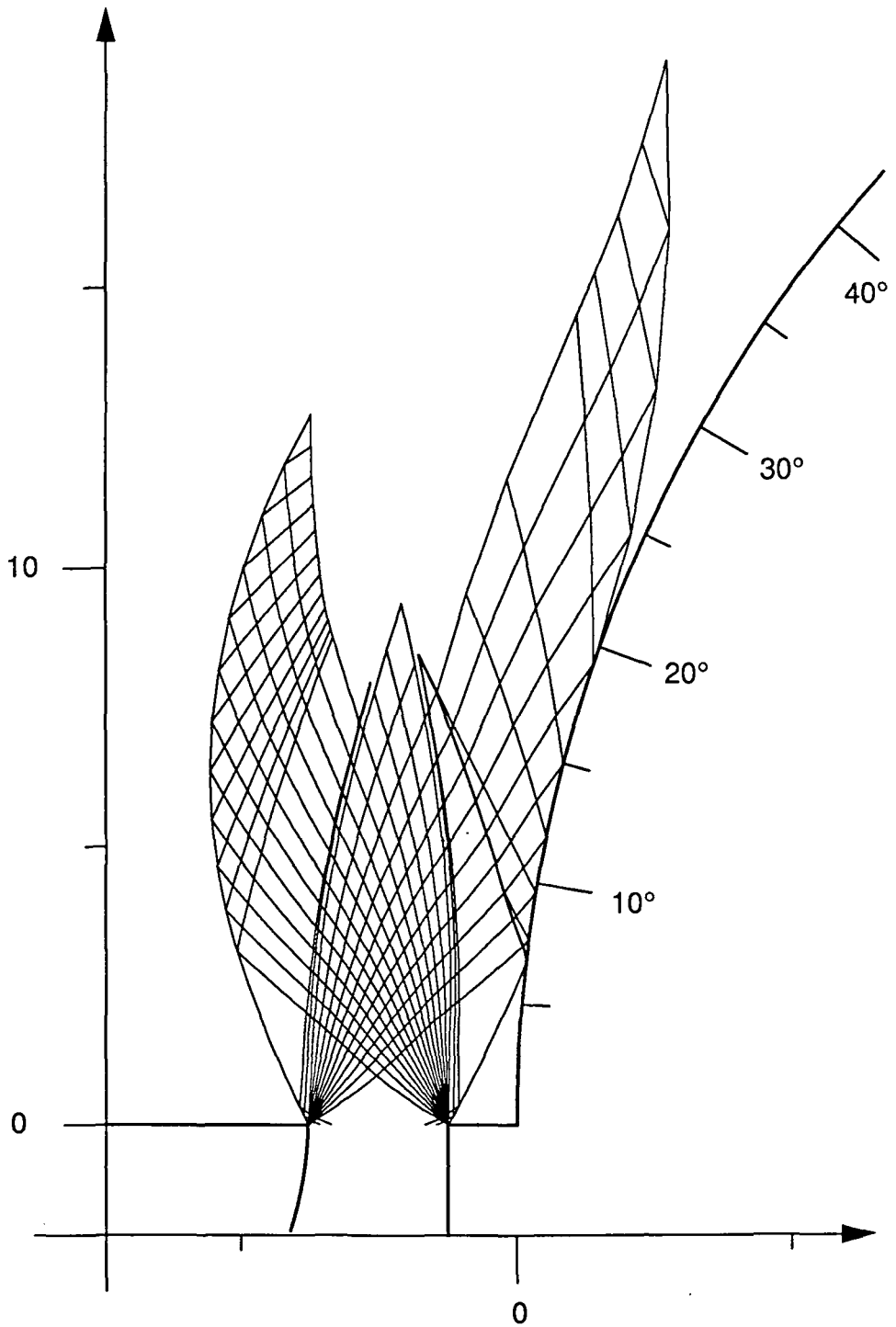


Figure 8.2.12. Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Slot = 5.00 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.225$



**Figure 8.2.13.** Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Base Pressure Model  
 Slot = 2.54 mm    Step = 1.25 mm  
 $P_{atm}/P_o = 0.163$



**Figure 8.2.14.**

Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Base Pressure Model  
 Slot = 2.54 mm    Step = 1.25 mm  
 $P_{atm}/P_o = 0.125$

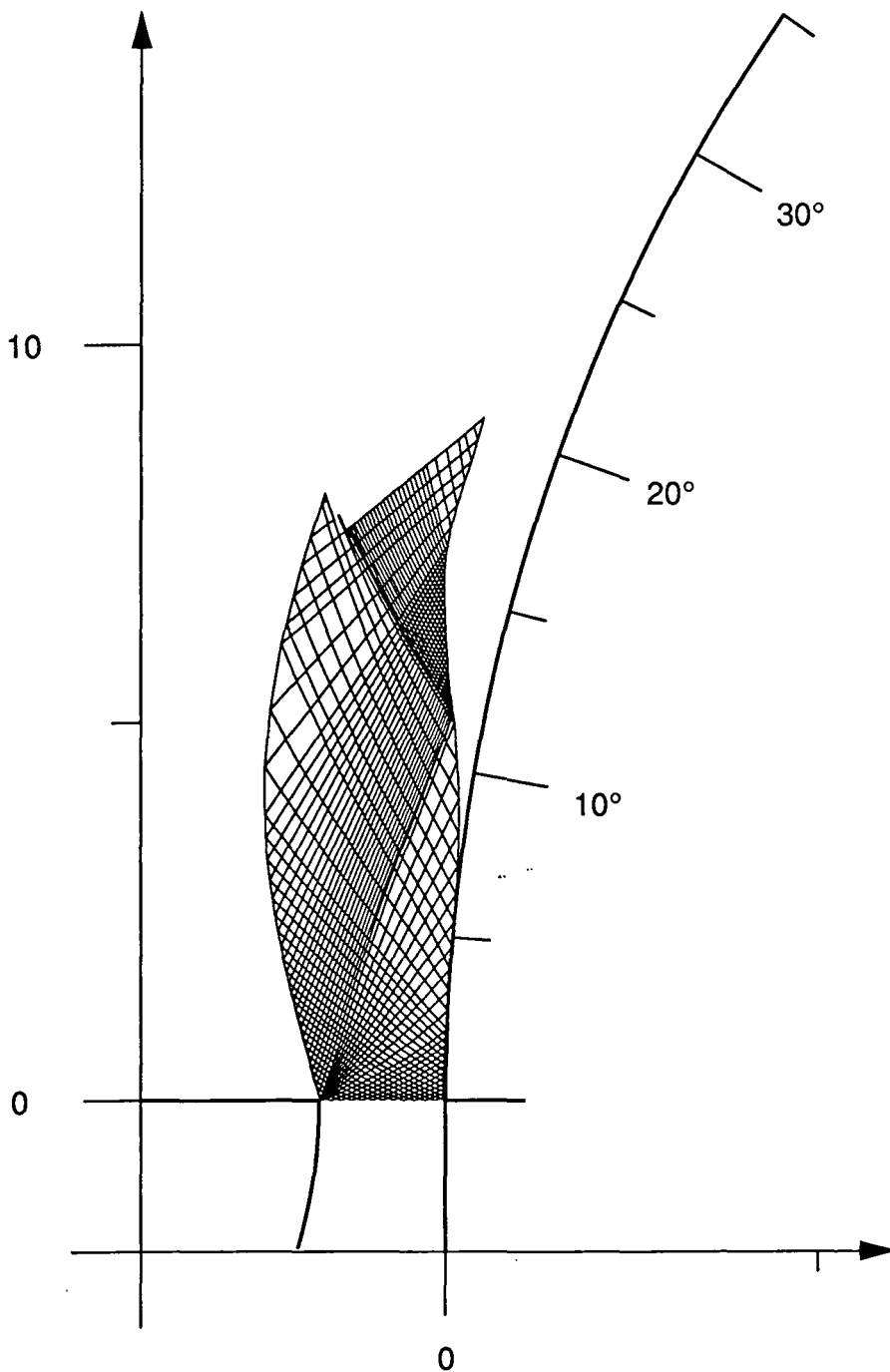


Figure 8.2.15. Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Experimental Surface Pressures  
 Slot = 1.67 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.202$

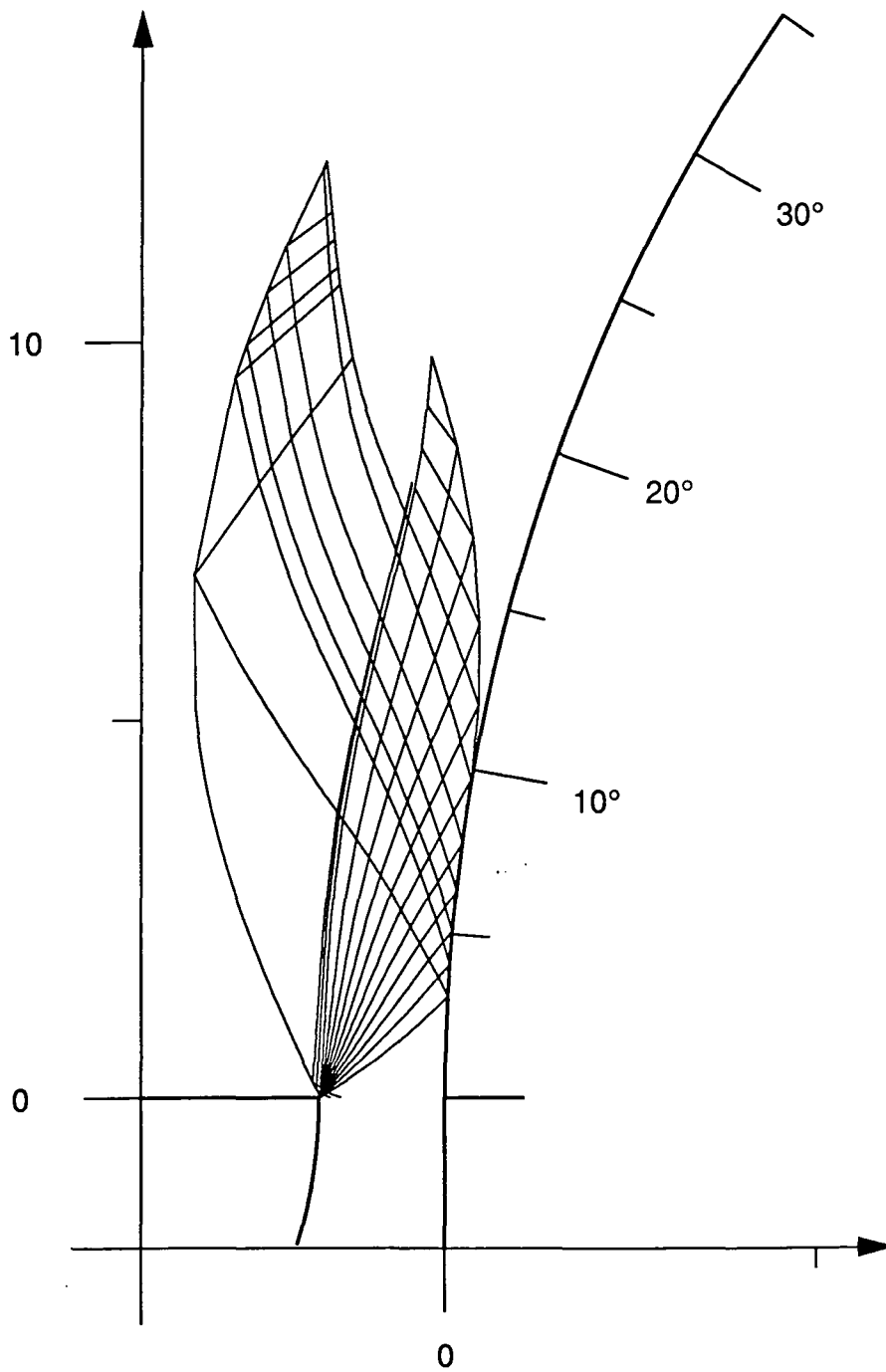


Figure 8.2.16.

Axisymmetric Coanda Model  
Method of Characteristics Plot

Shock Fitting; Experimental Surface Pressures  
 Slot = 1.67 mm    Step = 0.00 mm  
 $P_{atm}/P_o = 0.124$



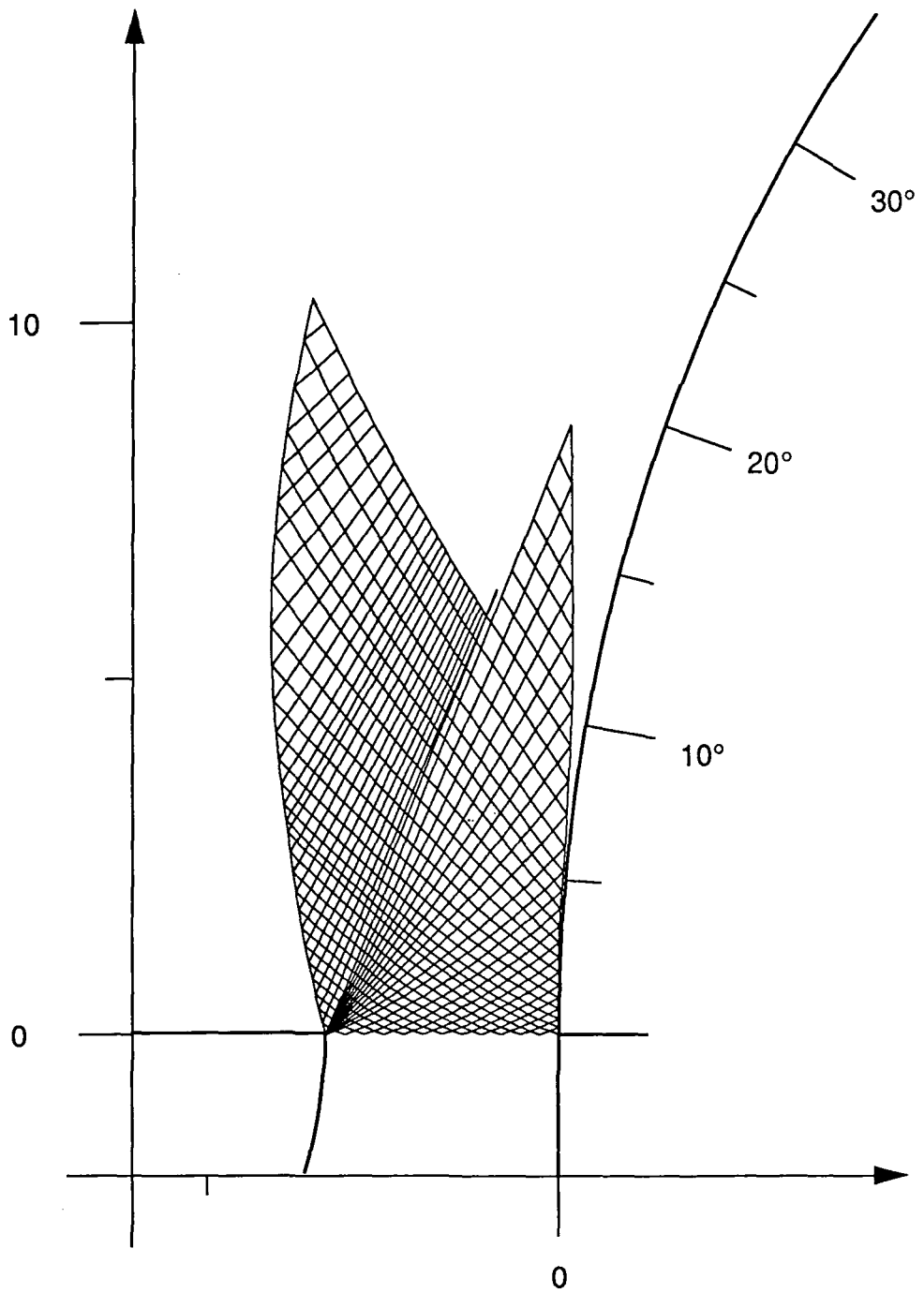
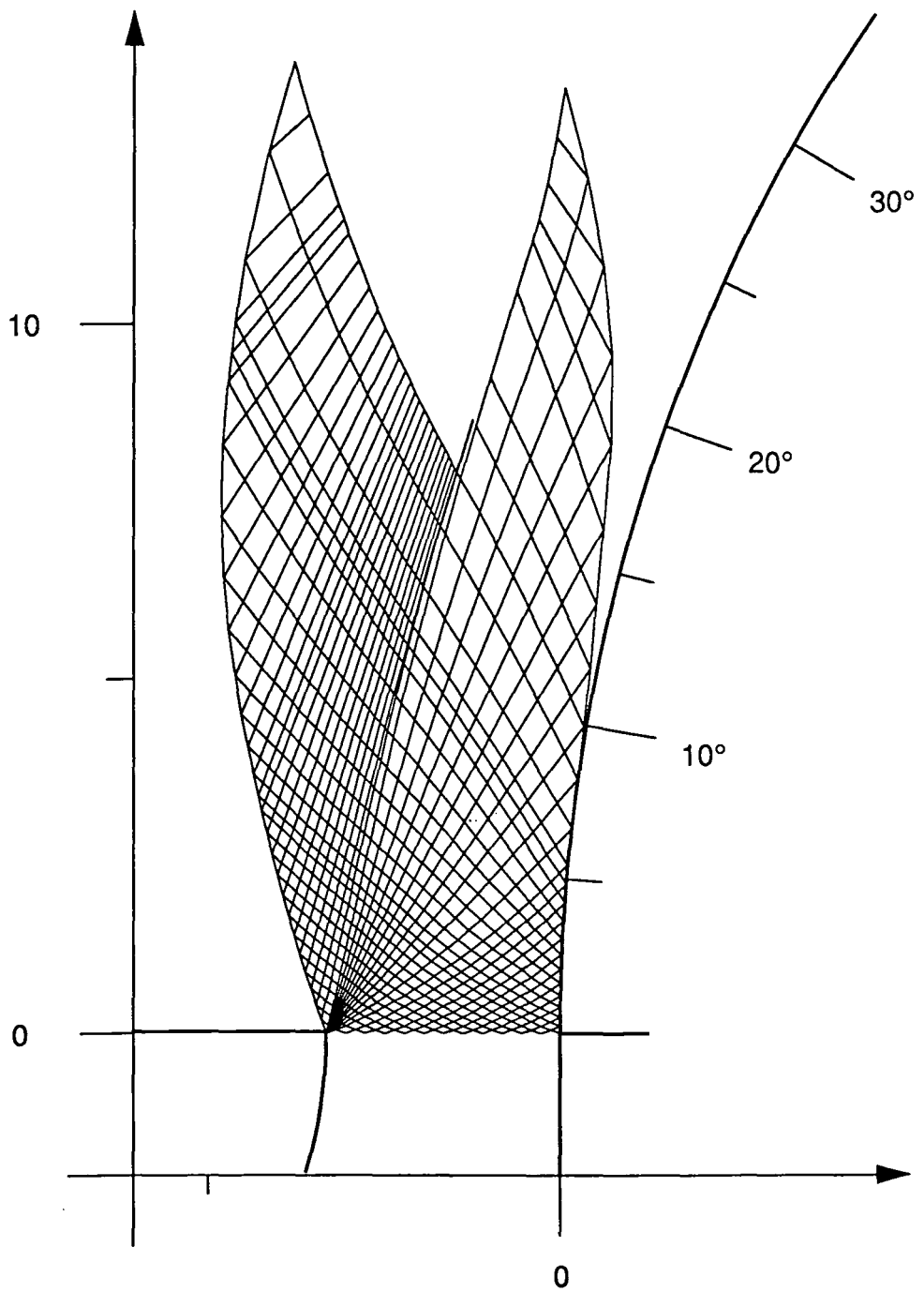
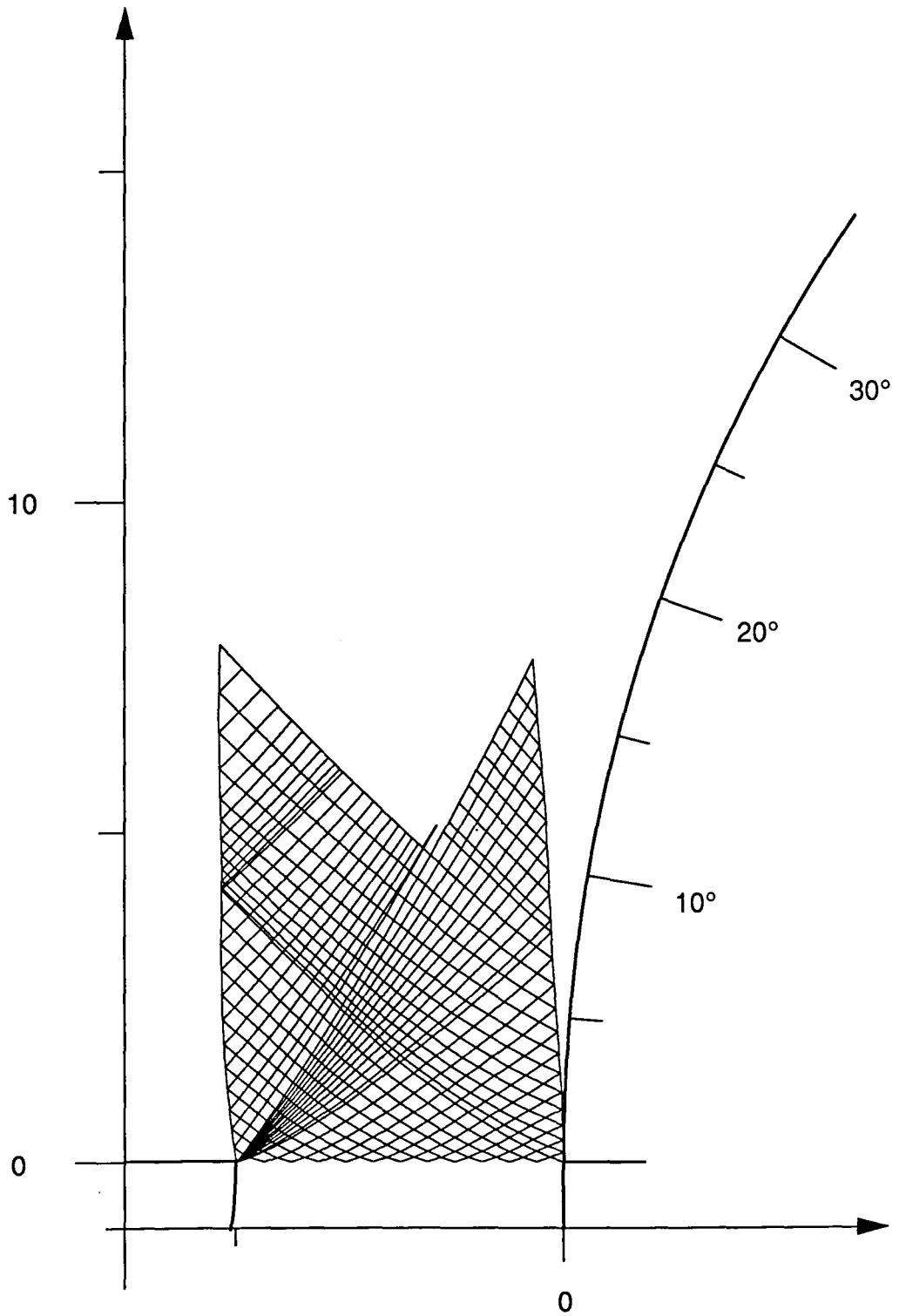


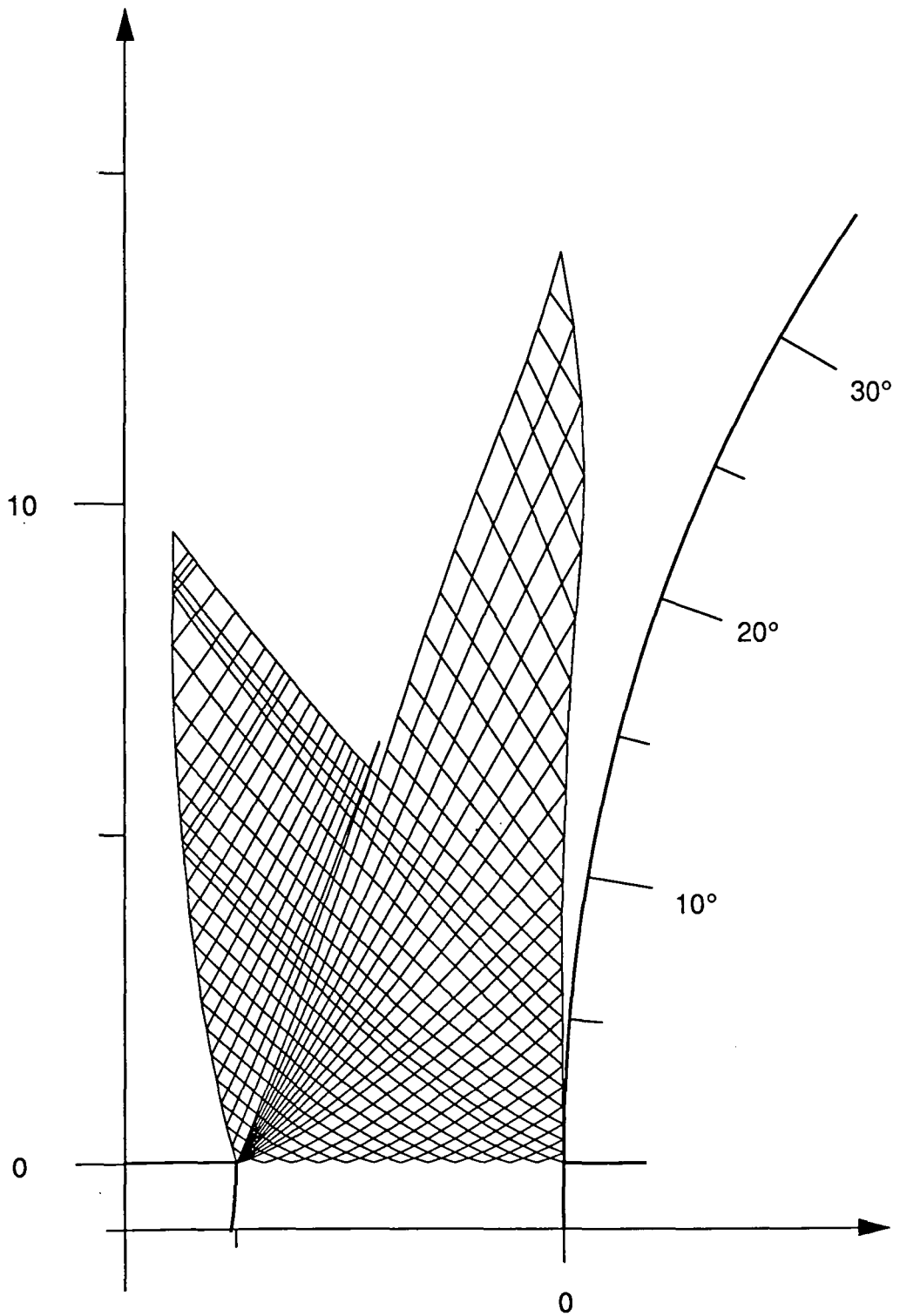
Figure 8.2.17. Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Experimental Surface Pressures  
 Slot = 3.33 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.233$



**Figure 8.2.18.** Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Experimental Surface Pressures  
 Slot = 3.33 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.174$



**Figure 8.2.19.** Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Experimental Surface Pressures  
 Slot = 5.00 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.314$



**Figure 8.2.20.** Axisymmetric Coanda Model  
Method of Characteristics Plot  
 Shock Fitting; Experimental Surface Pressures  
 Slot = 5.00 mm Step = 0.00 mm  
 $P_{atm}/P_o = 0.225$

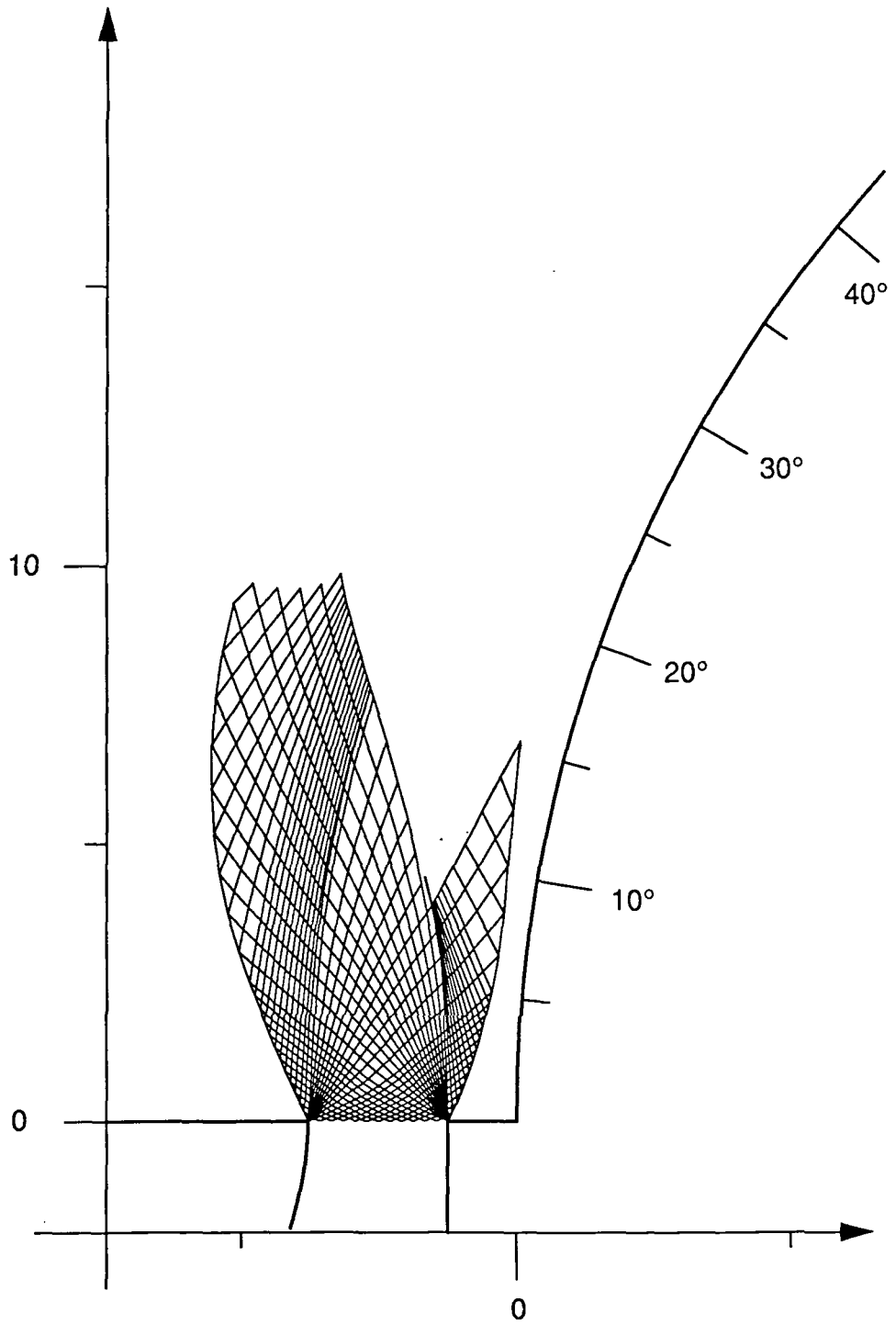


Figure 8.2.21.

Axisymmetric Coanda Model  
Method of Characteristics Plot

Shock Fitting; Experimental Surface Pressures

Slot = 2.54 mm Step = 1.25 mm

$P_{atm}/P_o = 0.125$

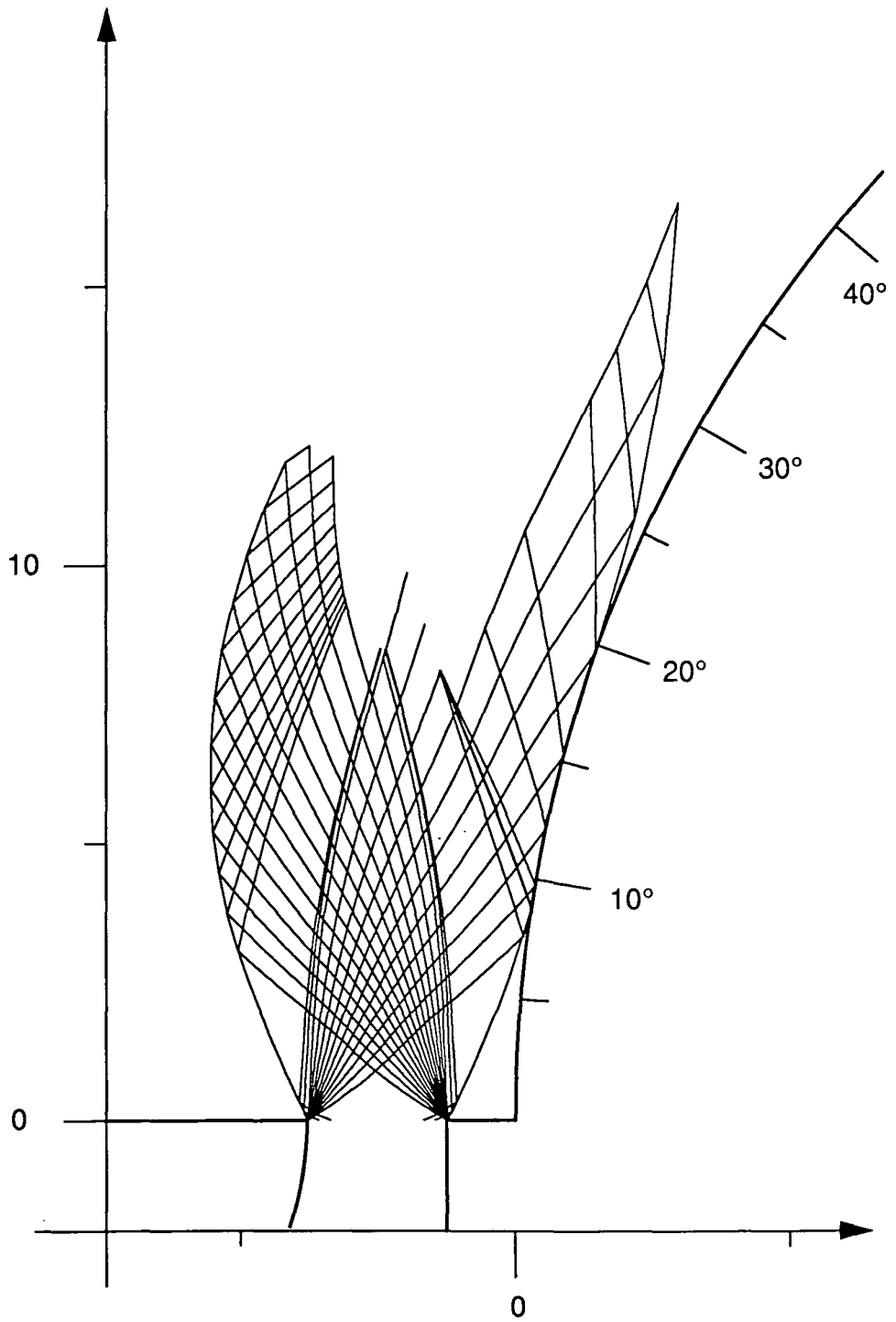


Figure 8.2.22.

Axisymmetric Coanda Model  
Method of Characteristics Plot

Shock Fitting; Separation Model

Experimental Base Pressure

Slot = 2.54 mm Step = 1.25 mm

$P_{atm}/P_o = 0.125$

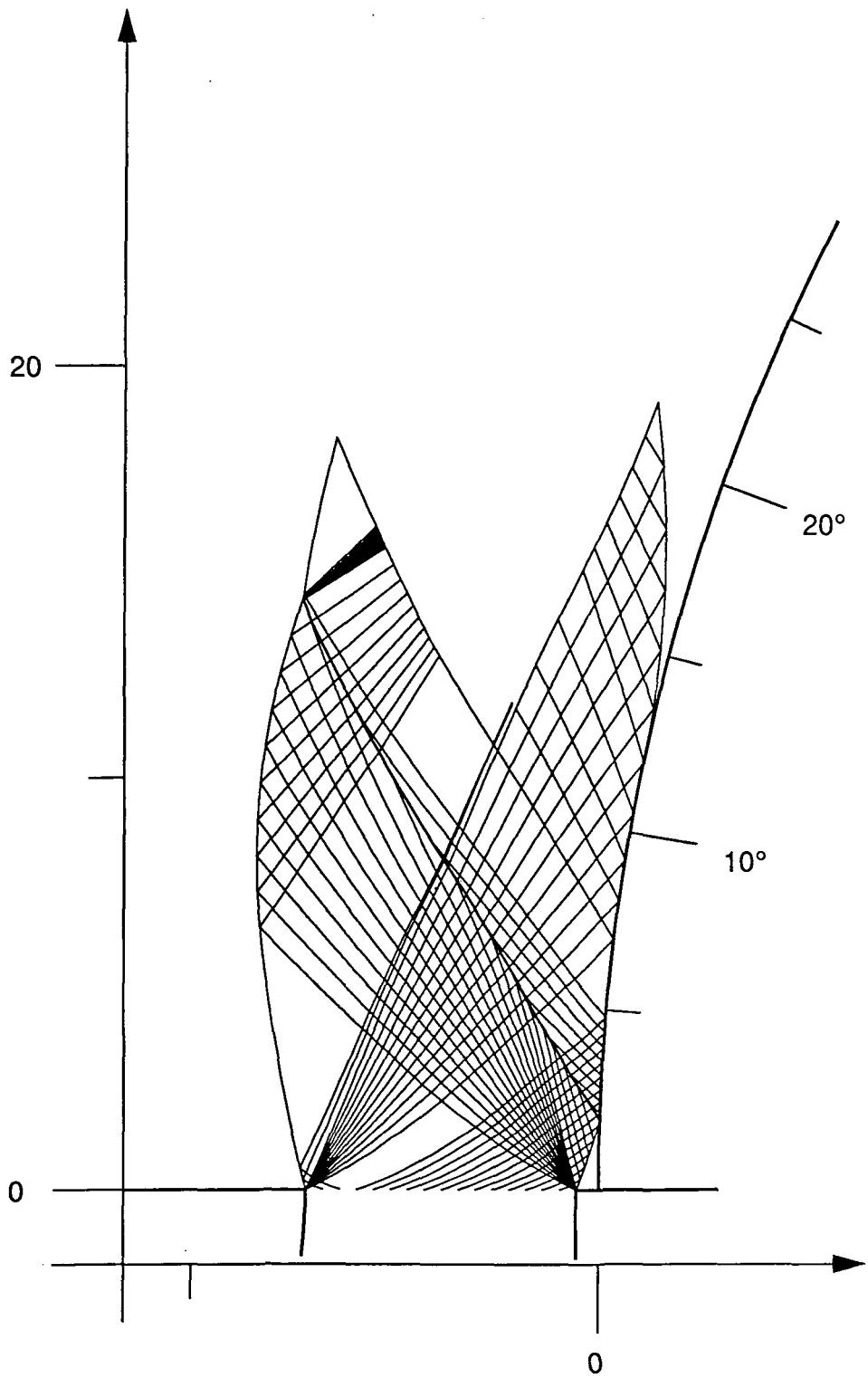
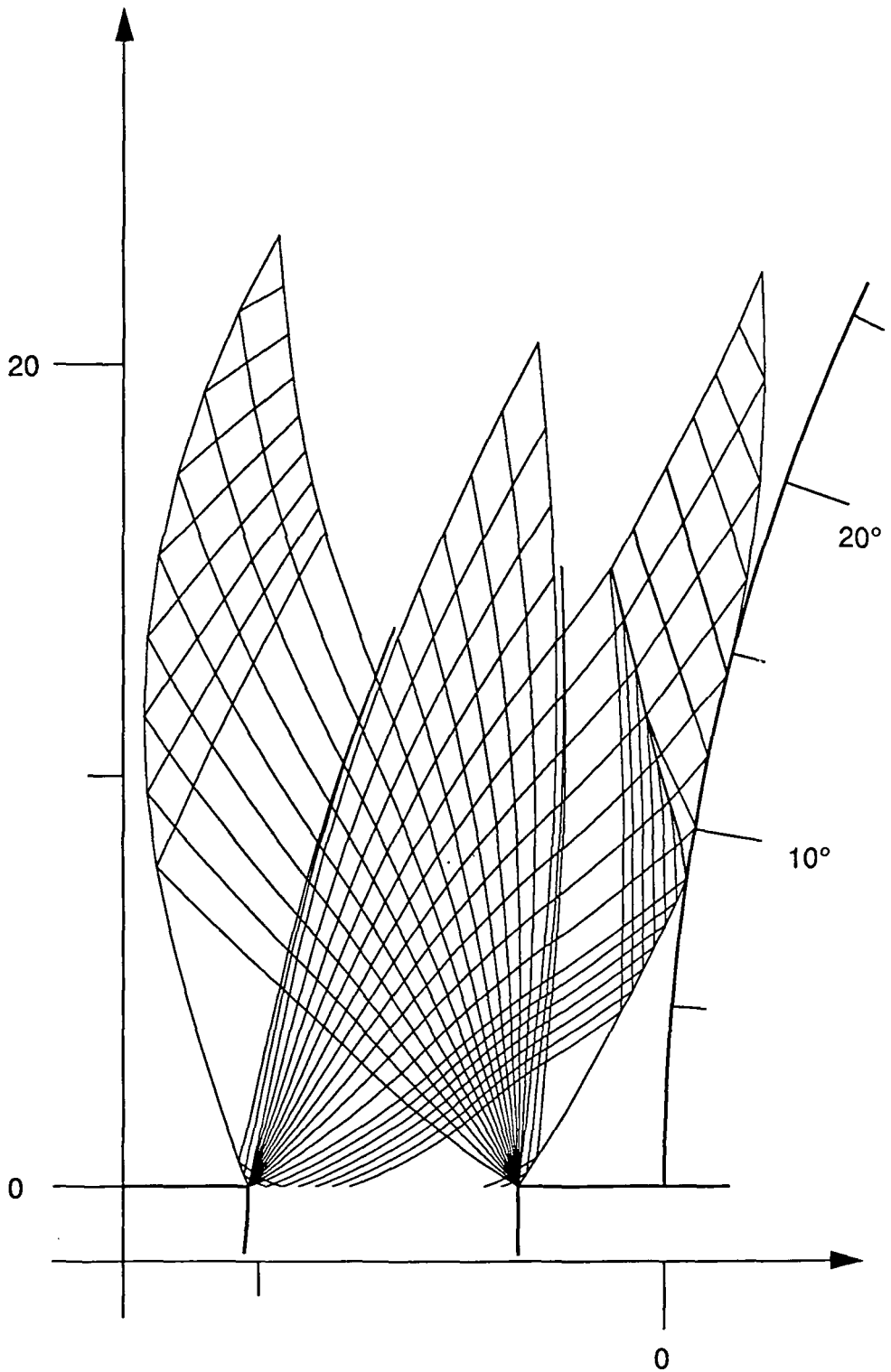


Figure 8.2.23. 18 Coanda (Field Tests)  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Base Pressure Model  
 Slot = 6.65 mm    Step = 0.55 mm  
 $P_{atm}/P_o = 0.252$



**Figure 8.2.24.** 18 Coanda (Field Tests)  
Method of Characteristics Plot  
 Shock Fitting; Separation Model  
 Base Pressure Model  
 Slot = 6.65 mm    Step = 3.60 mm  
 $P_{atm}/P_o = 0.184$





SHADOWGRAPH

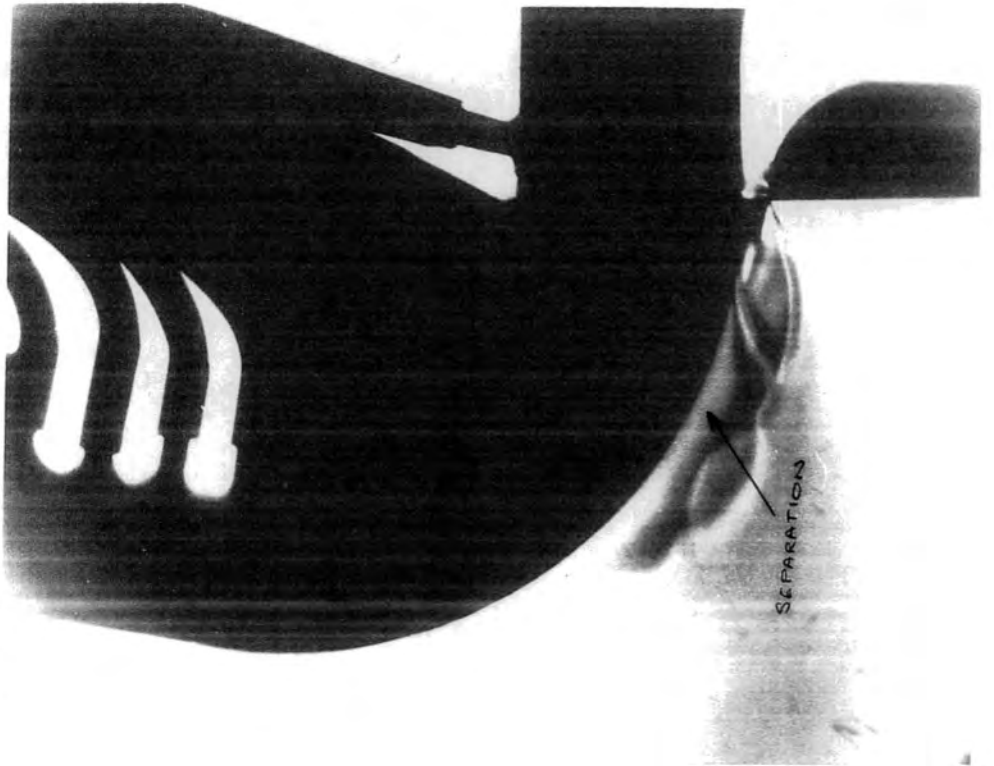


Plate 1a

SLOT 2.00 STEP 0.00  
C<sub>po</sub> 0.176

SHADOWGRAPH

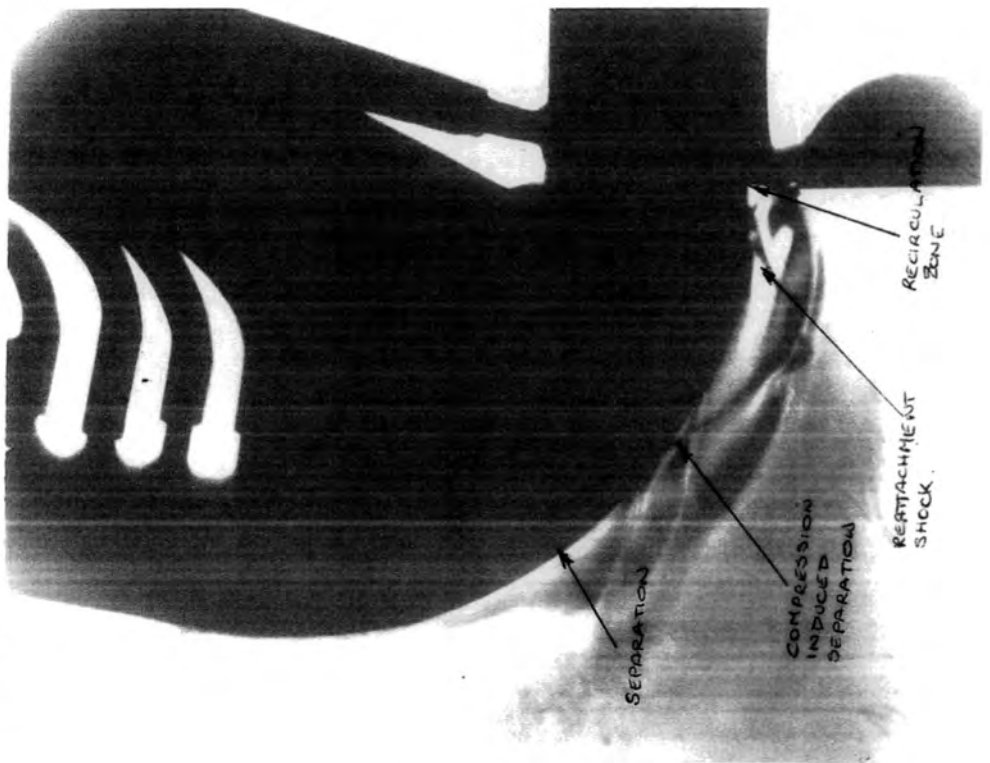


Plate 1b

SLOT 2.00 STEP 1.50  
C<sub>po</sub> 0.124

INTERFEROGRAM

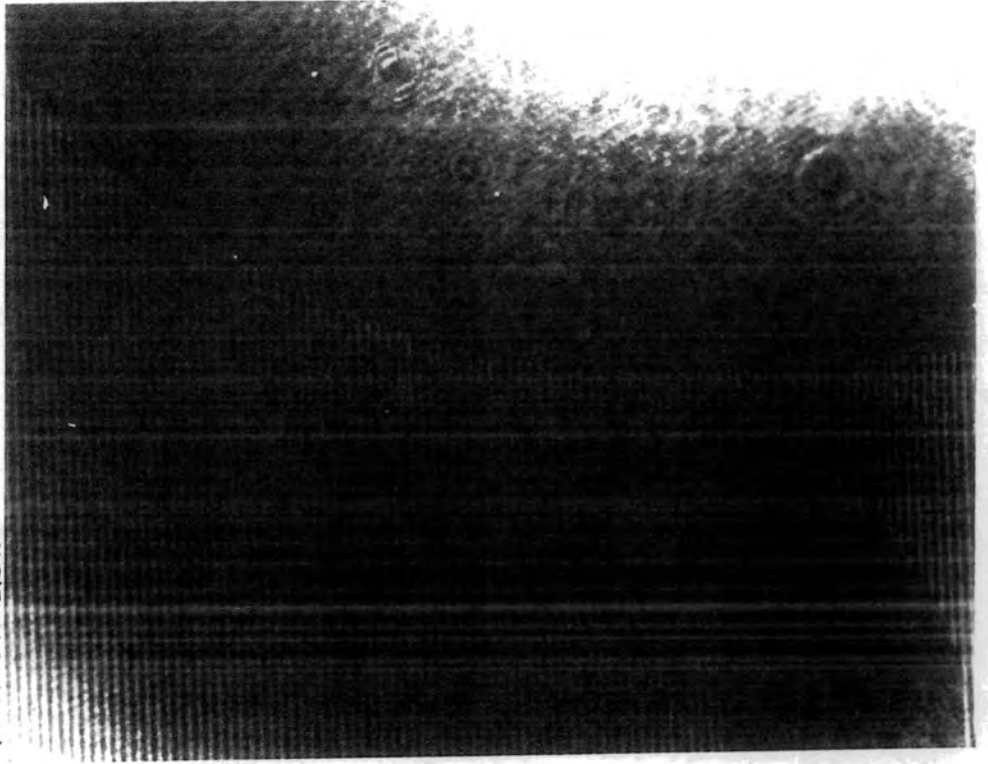


Plate 2a

SLOT 4.00 STEP 0.00  
NO FLOW

INTERFEROGRAM

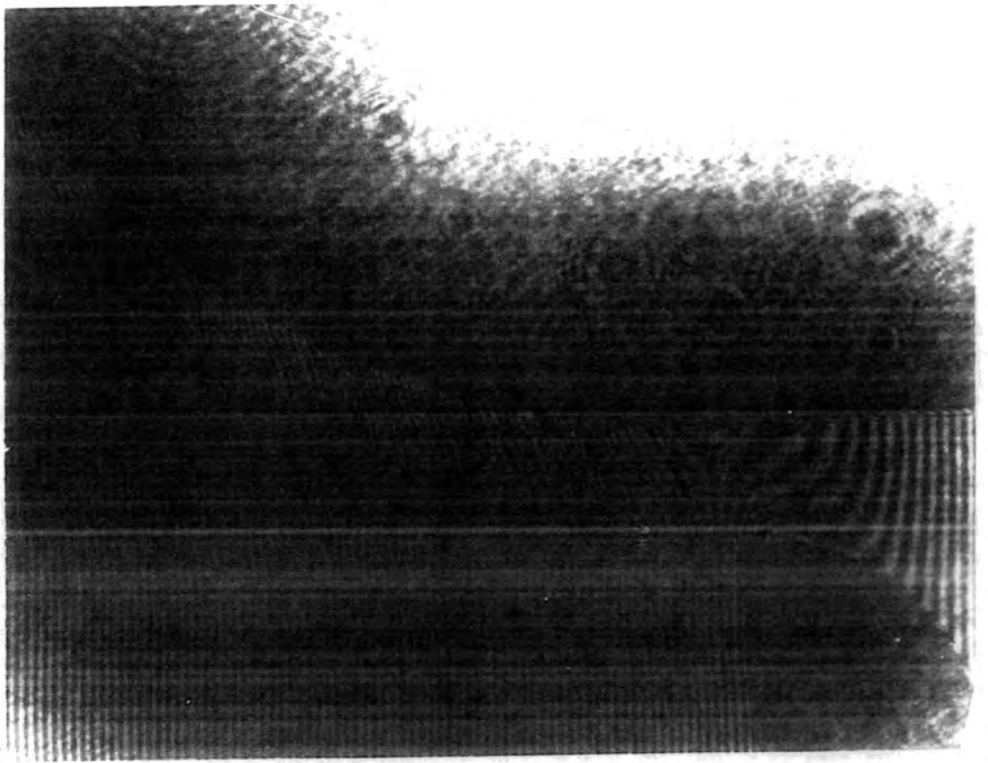


Plate 2b

SLOT 4.00 STEP 0.00  
 $C_{p0}$  0.488

SHADOWGRAPH

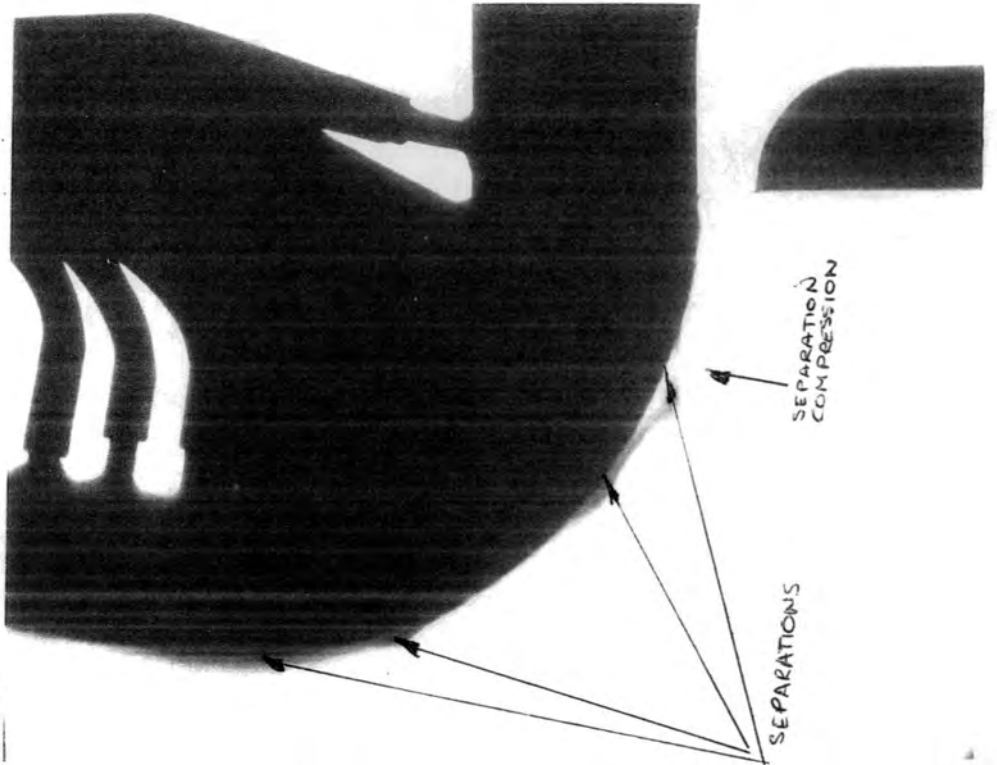


Plate 3a

SLOT 4.00  
 $C_{po}$  0.325

STEP 0.00

SPARK SCHLIEREN (Vke)

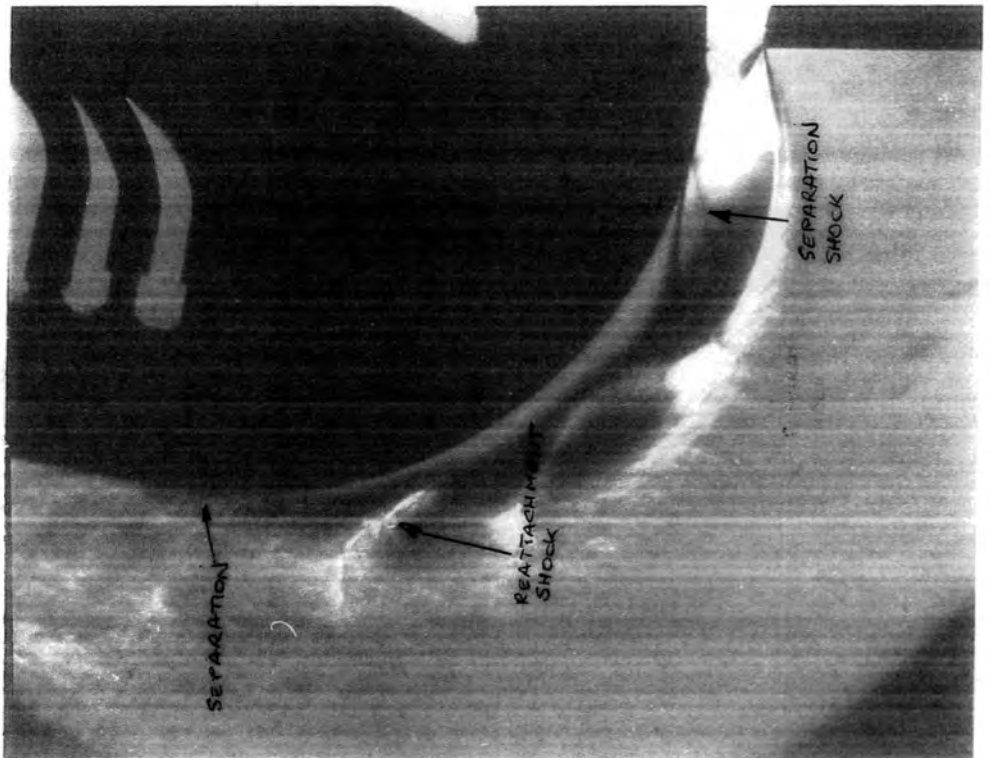


Plate 3b

SLOT 4.00  
 $C_{po}$  0.256

STEP 0.00

SURFACE OIL FLOW

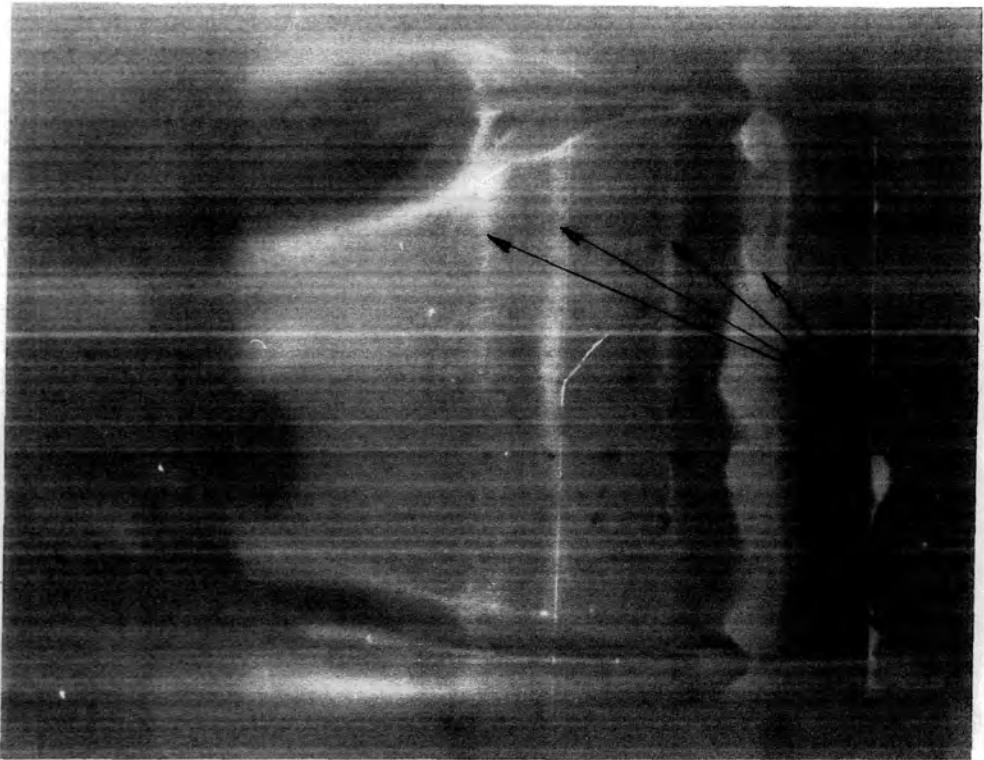


Plate 4a SLOT 4.00 STEP 0.00  
C<sub>po</sub> 0.324

SURFACE OIL FLOW

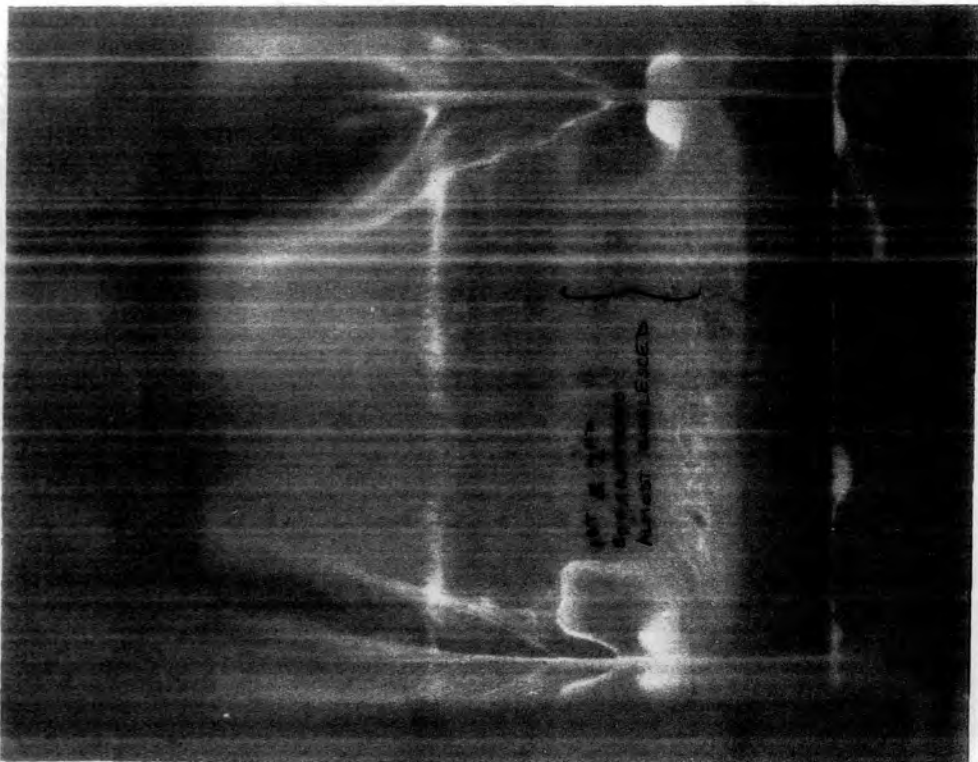


Plate 4b SLOT 4.00 STEP 0.00  
C<sub>po</sub> 0.256

INTERFEROGRAM

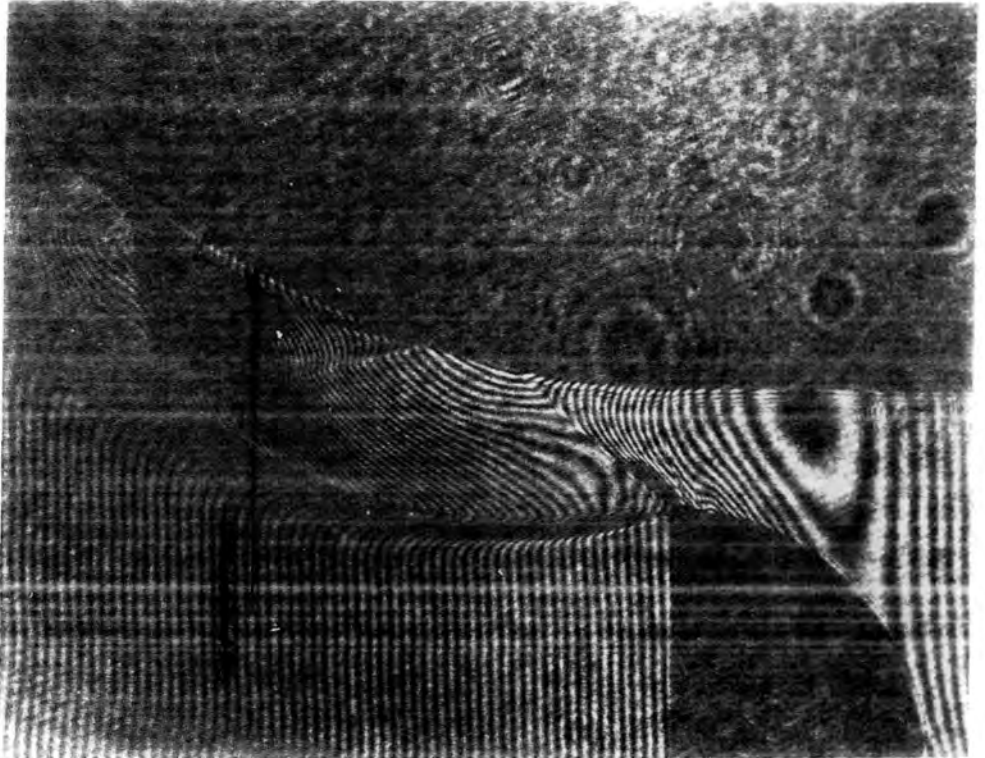


Plate 5a SLOT 4.00 STEP 0.00  
 $C_p$  0.312

INTERFEROGRAM

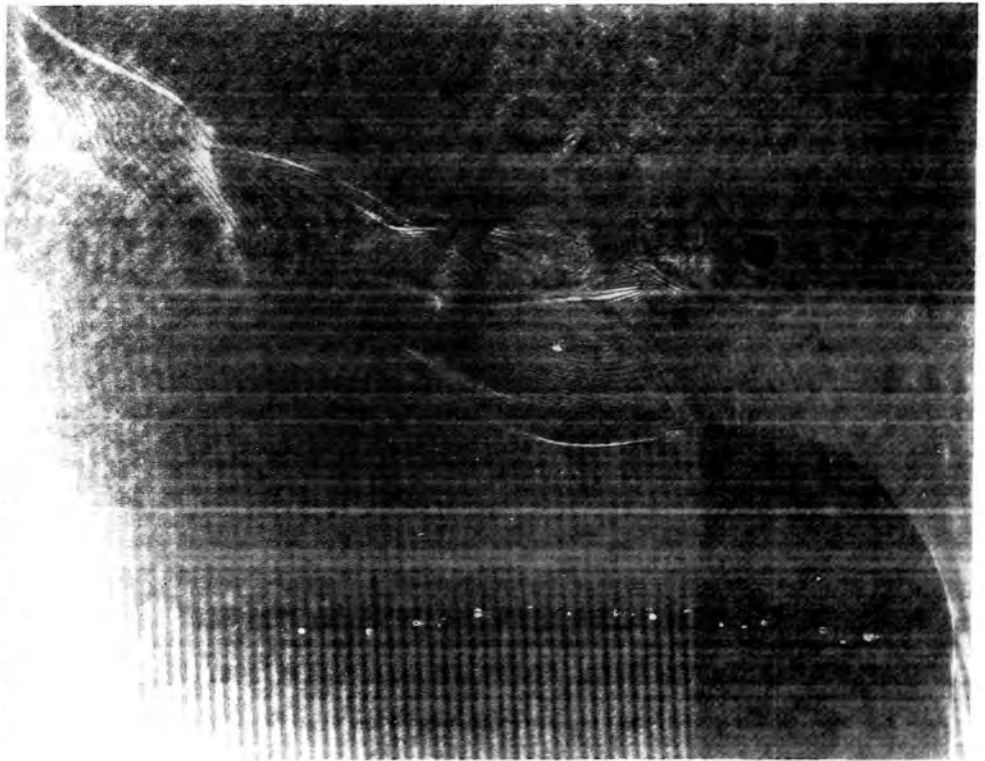


Plate 5b SLOT 4.00 STEP 1.50  
 $C_p$  0.338

SURFACE OIL FLOW

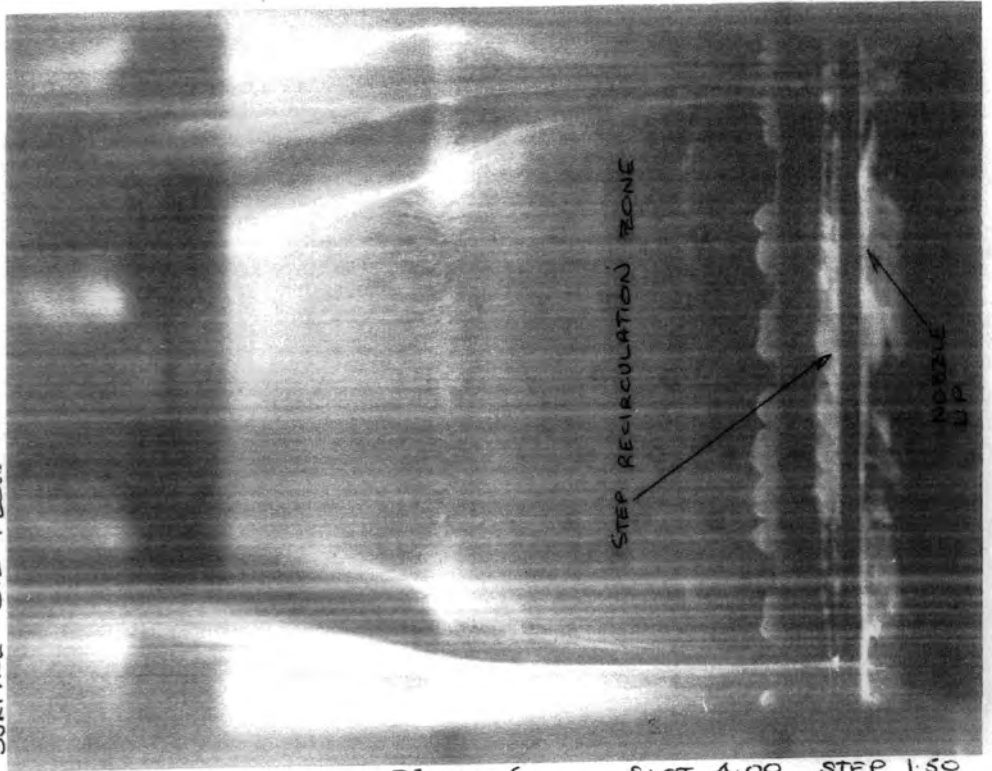


Plate 6a

SLOT 4.00 STEP 1.50  
 $C_{p0}$  0.331

SURFACE OIL FLOW

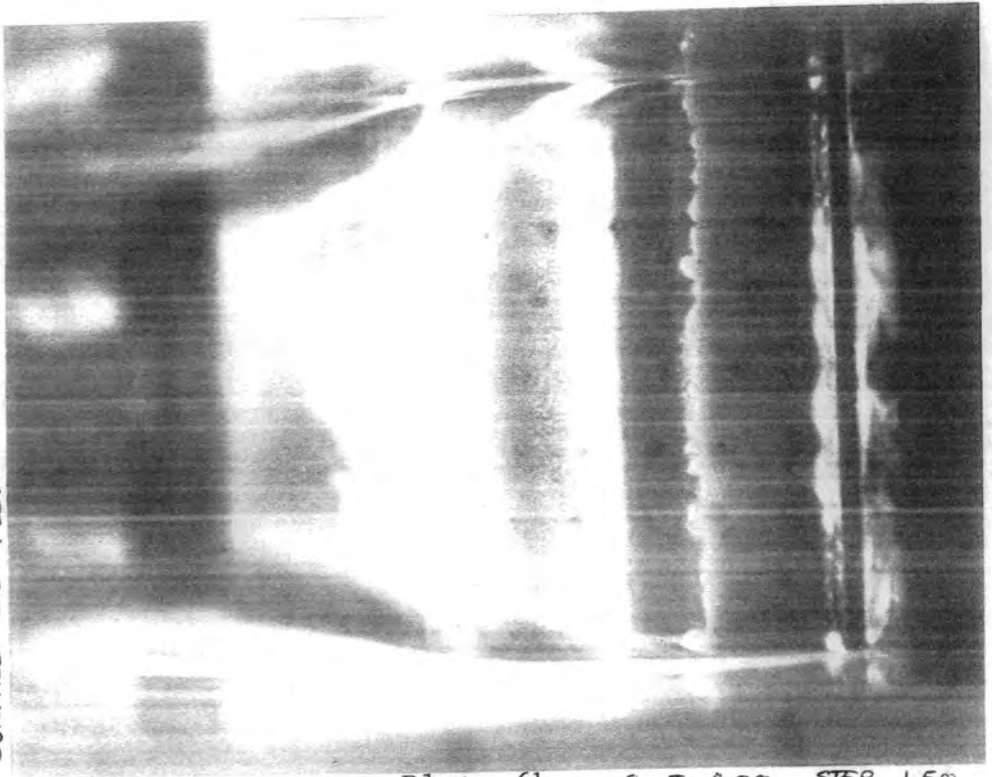


Plate 6b

SLOT 4.00 STEP 1.50  
 $C_{p0}$  0.256

SCHLIEREN (vke)

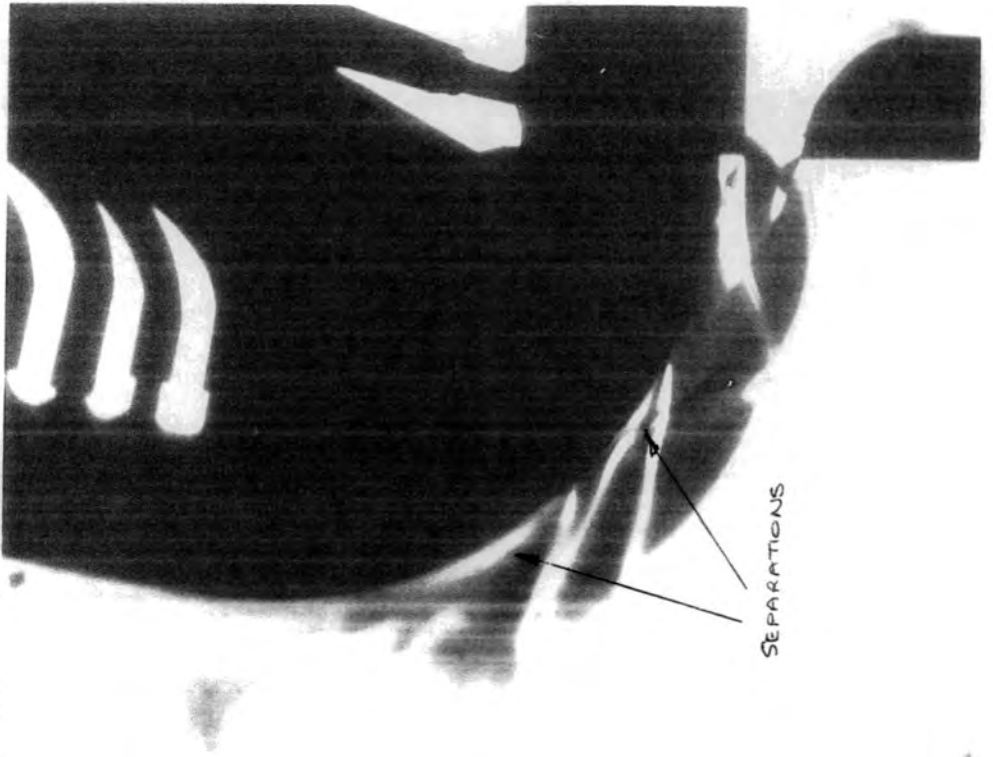


Plate 7a

SLOT 4.00  
 $C_{p0}$  0.212

STEP 1.50

SCHLIEREN (vke)

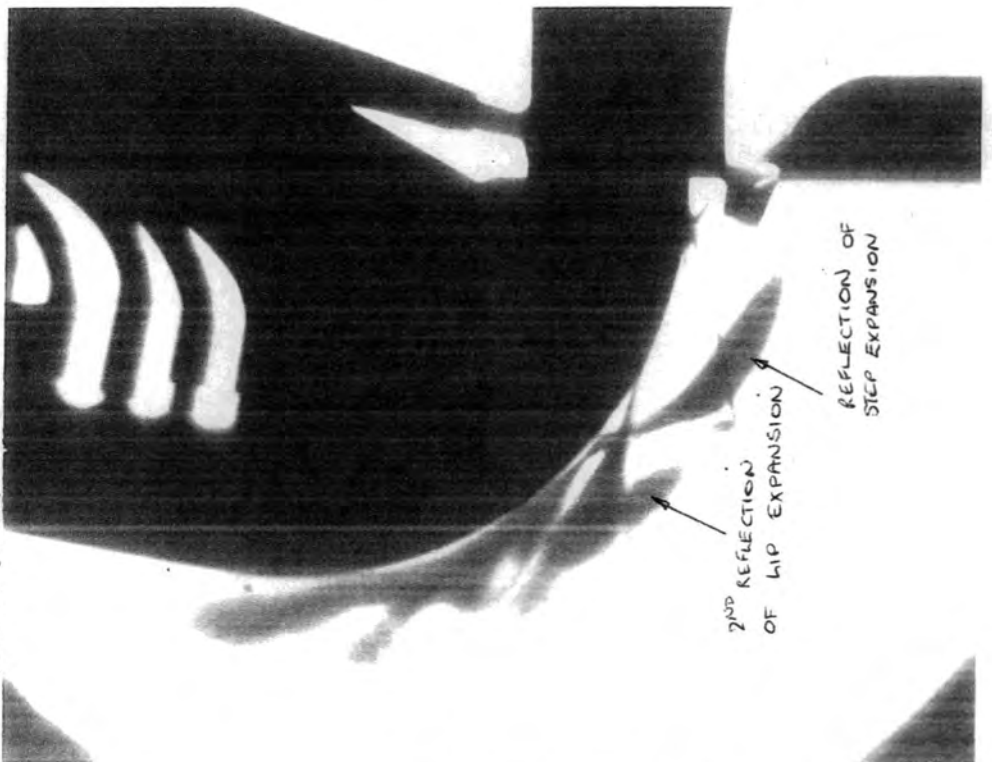


Plate 7b

SLOT 4.00  
 $C_{p0}$  0.205

STEP 2.55

SHADOWGRAPH

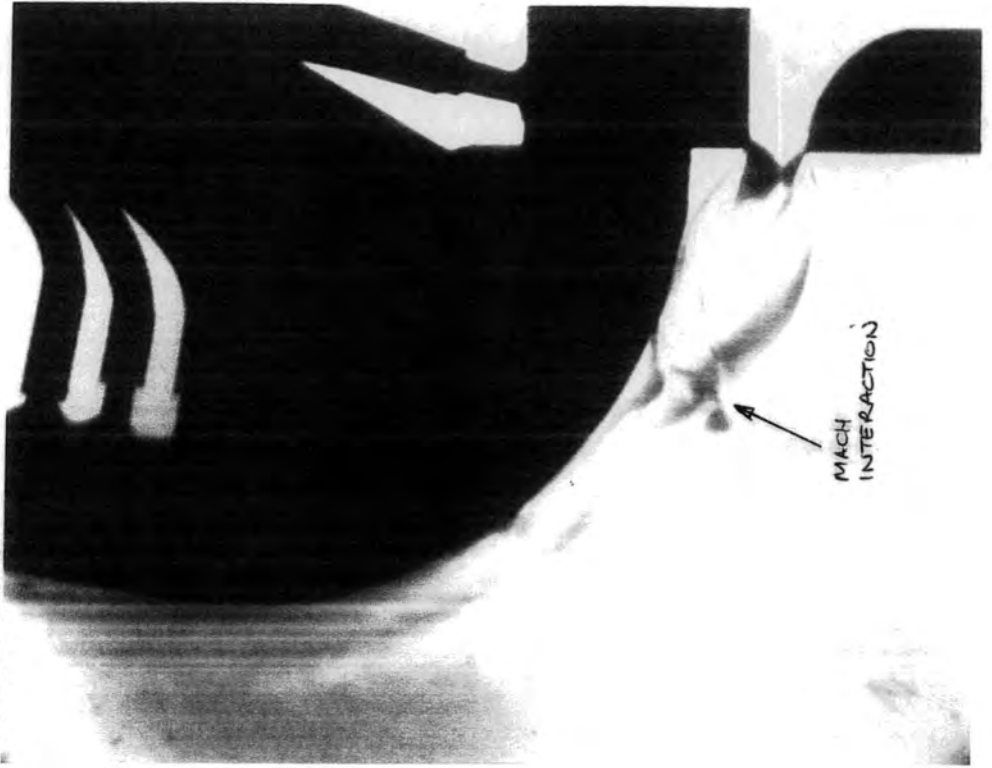


Plate 8a SLOT 4.00 STEP 3.76  
 $C_{po}$  0.228

SPARK SCHLIEREN (VKE)

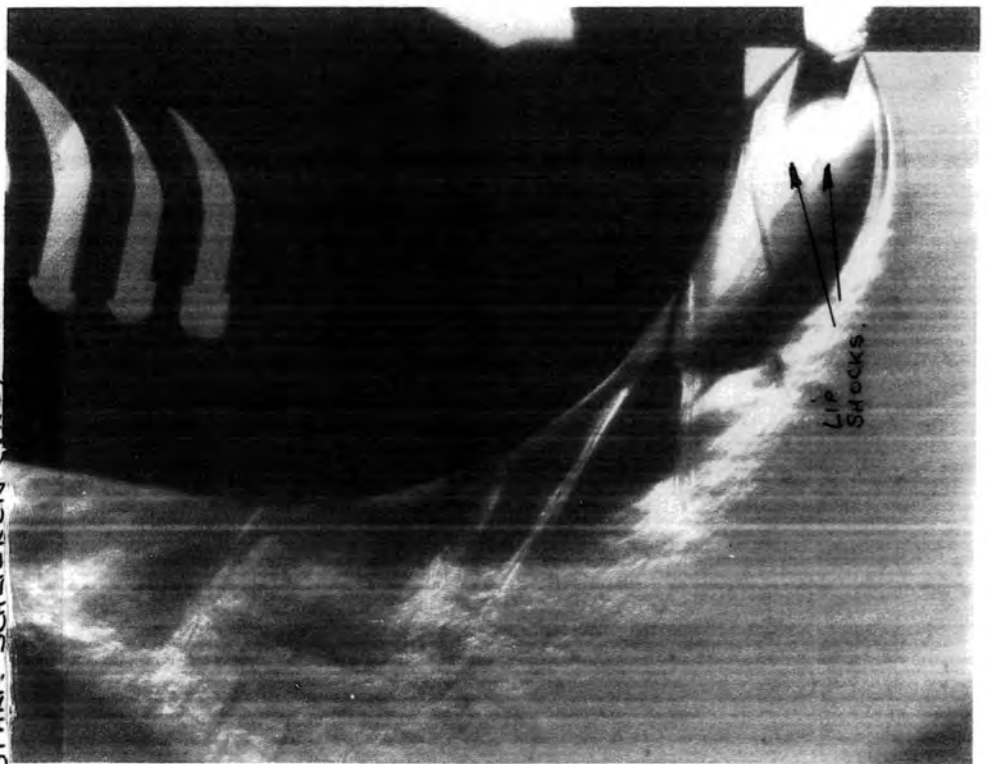


Plate 8b SLOT 4.00 STEP 3.76  
 $C_{po}$  0.191



SCHLIERN (vke)

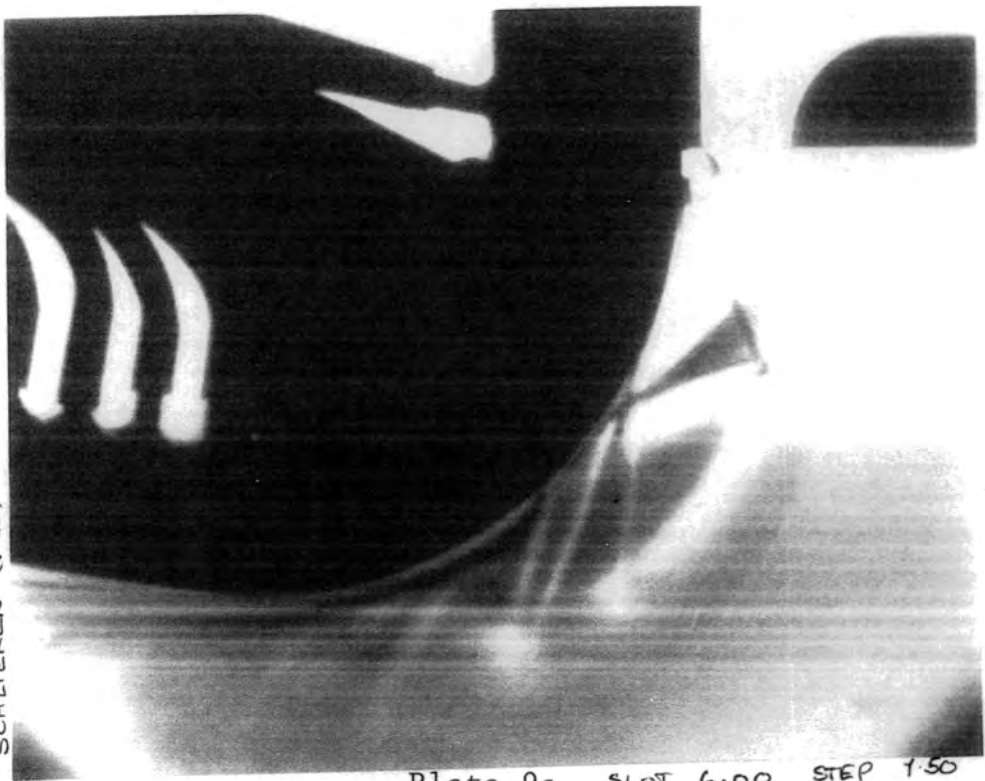


Plate 9a SLOT 6.00 STEP 1.50  
 $C_{po}$  0.290

SCHLIERN (vke)

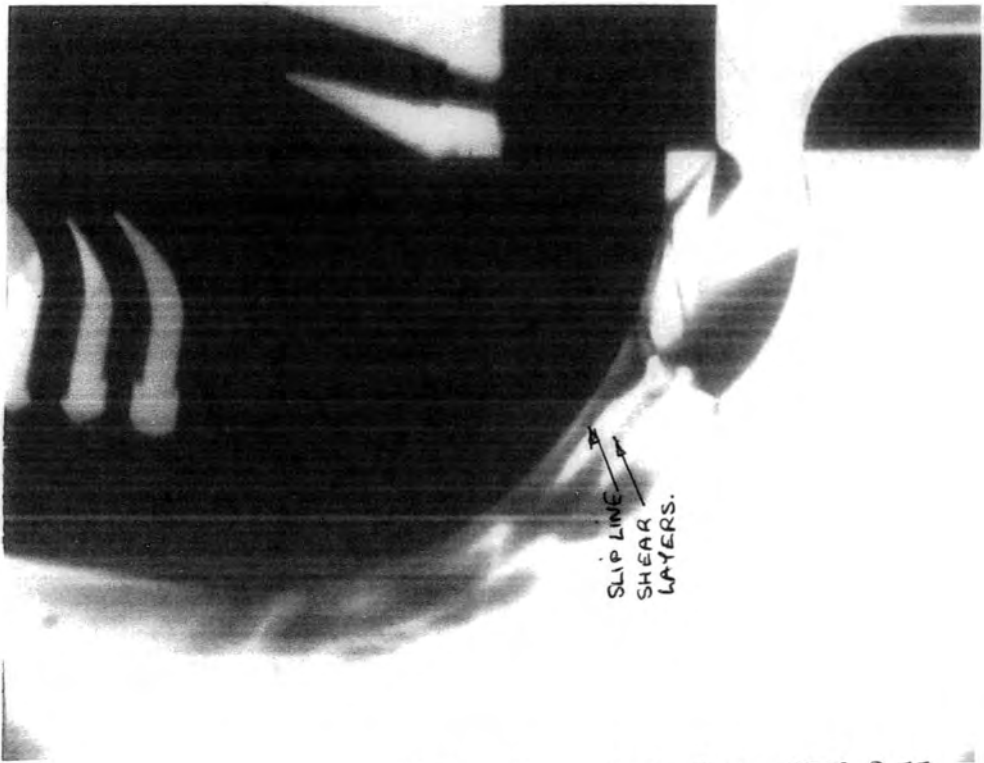


Plate 9b SLOT 6.00 STEP 3.75  
 $C_{po}$  0.315

PLANAR SCHLIEREN (hke)



Plate 10a    SLOT 8.00    STEP 1.49  
Cp: 0.359

AXISYMMETRIC SCHLIEREN (hke)

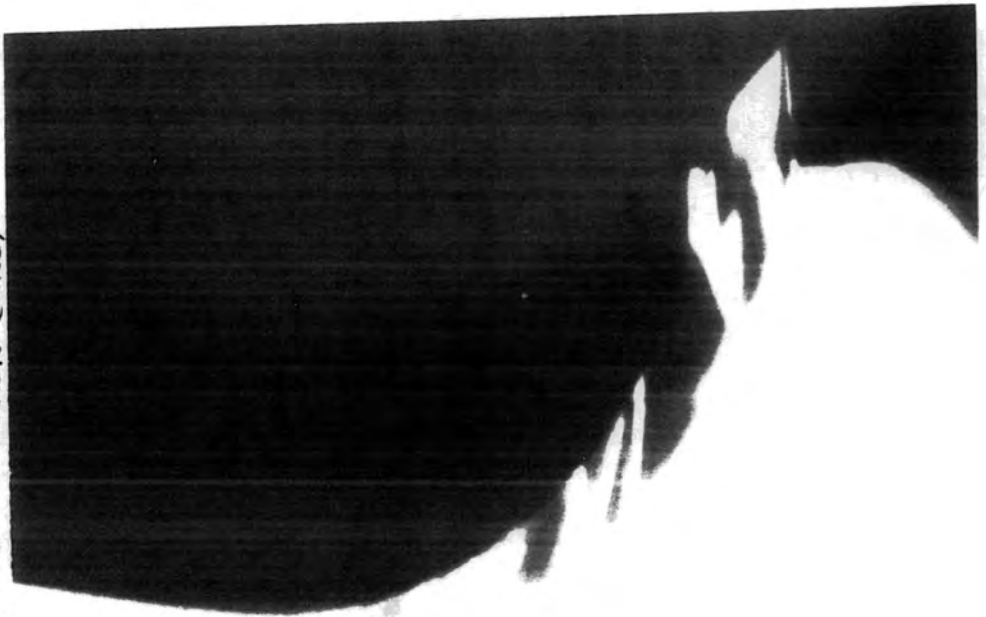


Plate 10b    SLOT 5.00    STEP 1.25  
Cp: 0.207

SCHLIEREN (hke)

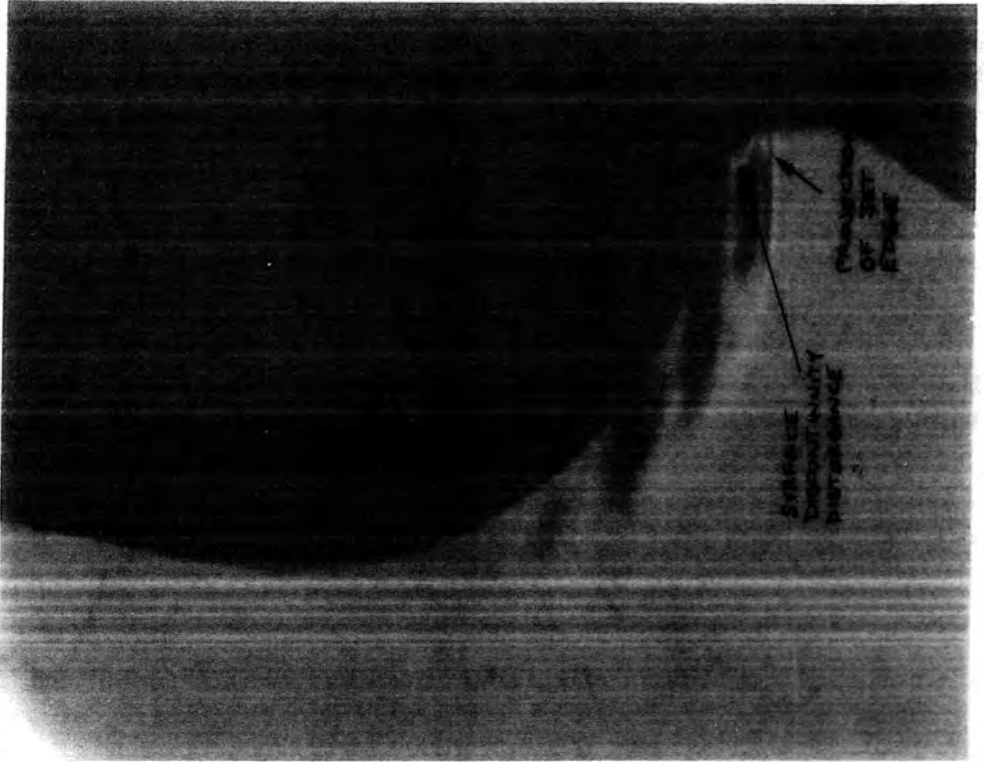


Plate 11a    SLOT 1.67    STEP 0.00  
C<sub>po</sub> 0.124

SCHLIEREN (vke)

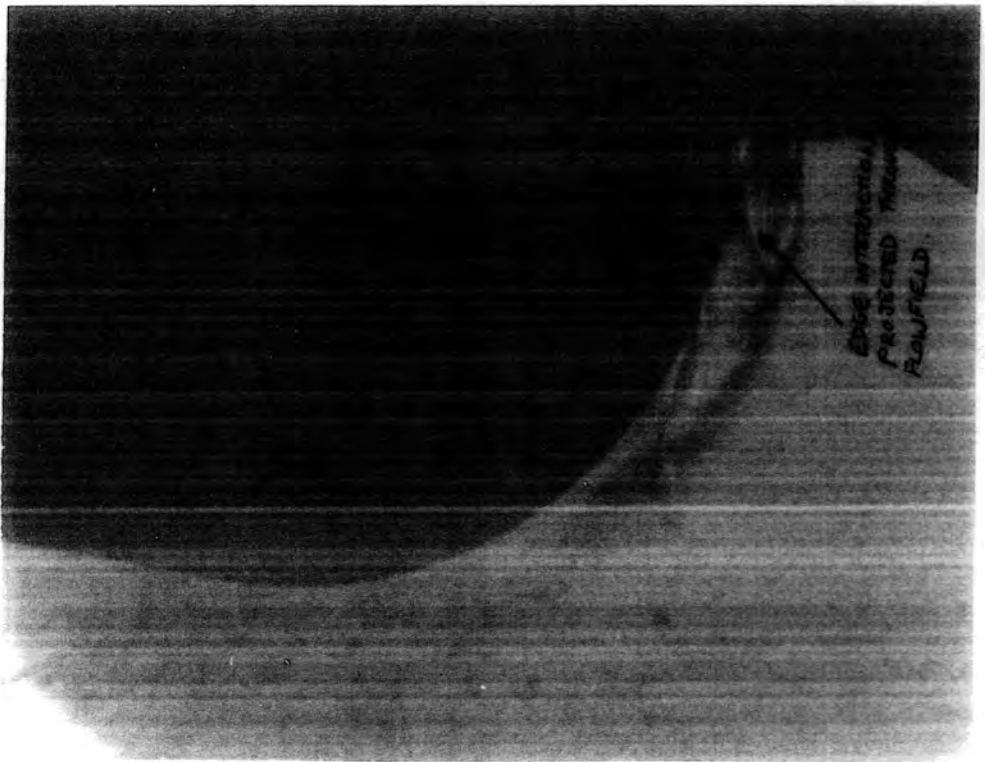


Plate 11b    SLOT 1.67    STEP 1.25  
C<sub>po</sub> 0.105

SCHLIEREN (hke)

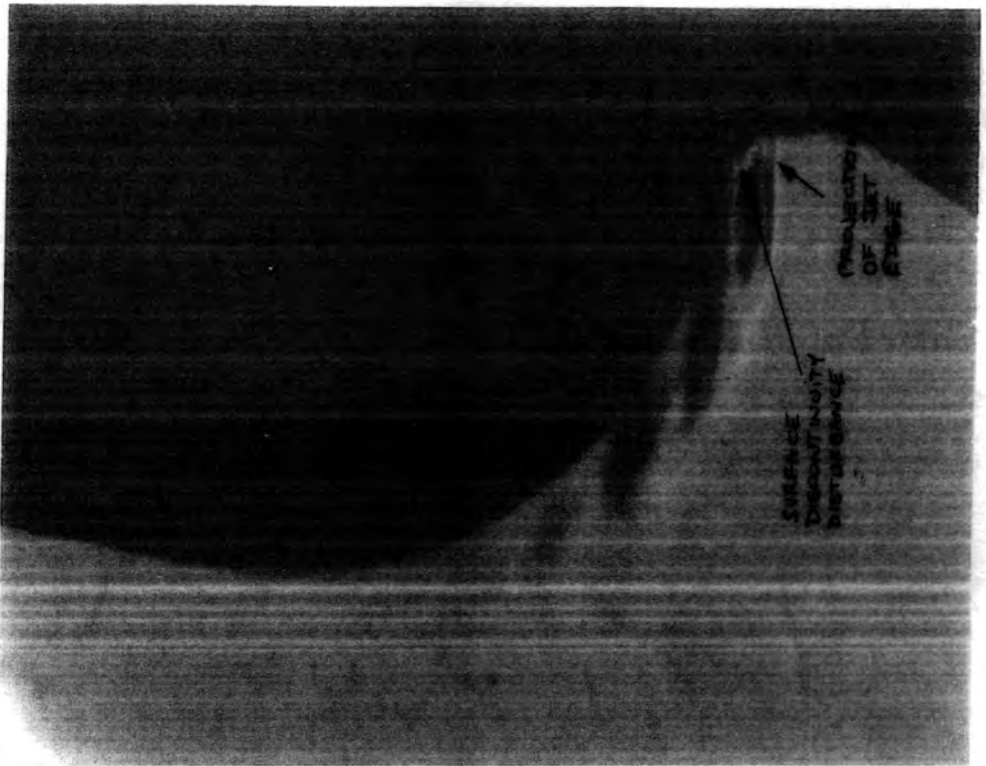


Plate 11a    SLOT 1.67    STEP 0.00  
C<sub>po</sub> 0.124

SCHLIEREN (vke)

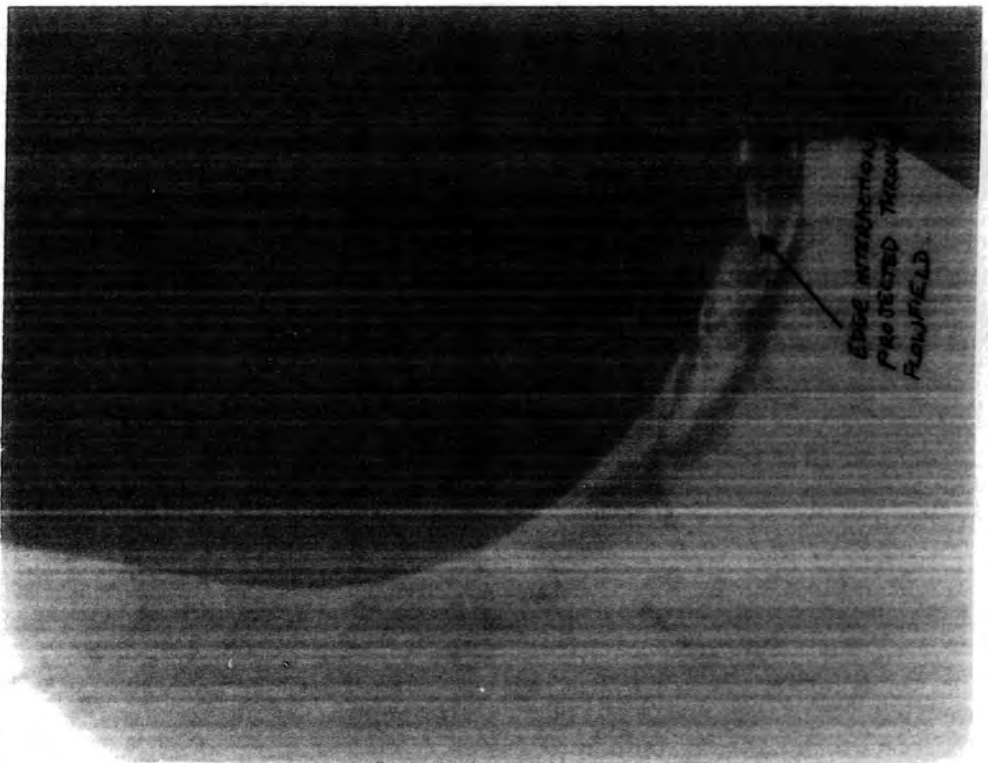


Plate 11b    SLOT 1.67    STEP 1.25  
C<sub>po</sub> 0.105

SURFACE OIL FLOW

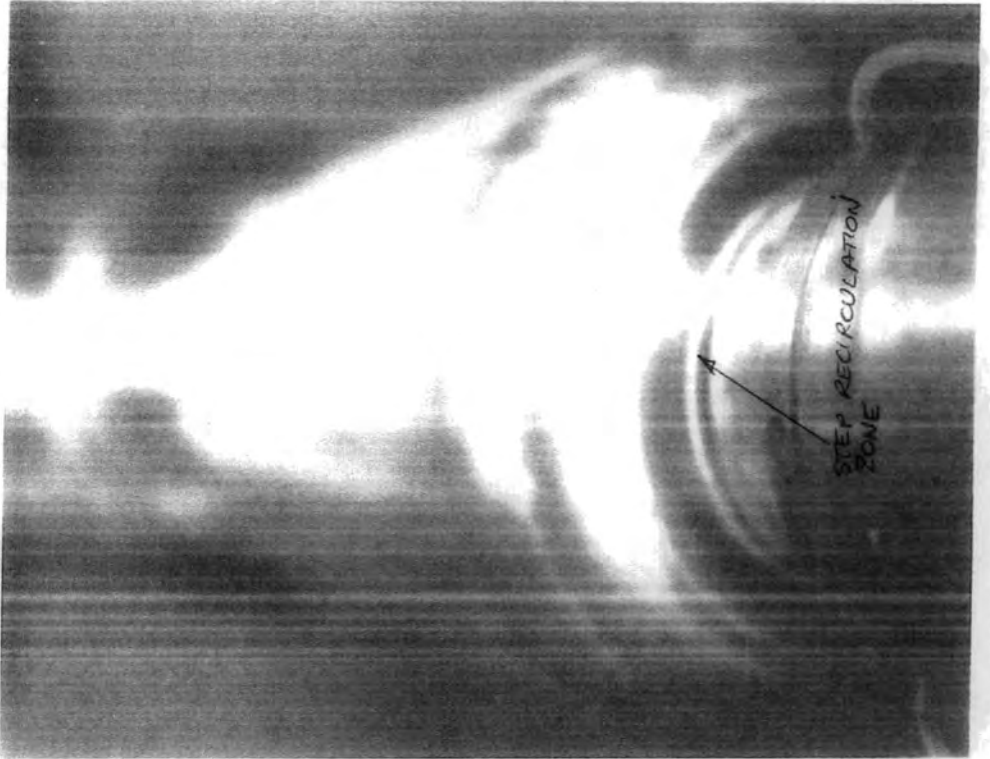


Plate 13a SLOT 2.54 STEP 1.25  
 $C_{po}$  0.125

SURFACE OIL FLOW

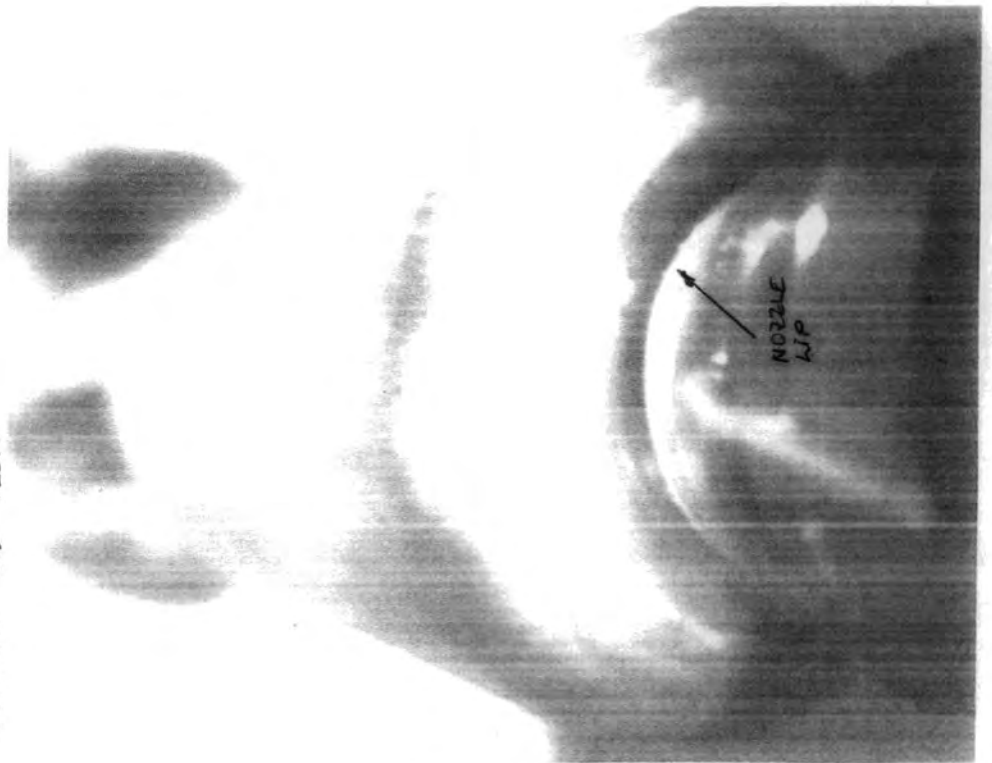


Plate 13b SLOT 3.33 STEP 0.00  
 $C_{po}$  0.174

SPARK SCHLIEREN (hke)

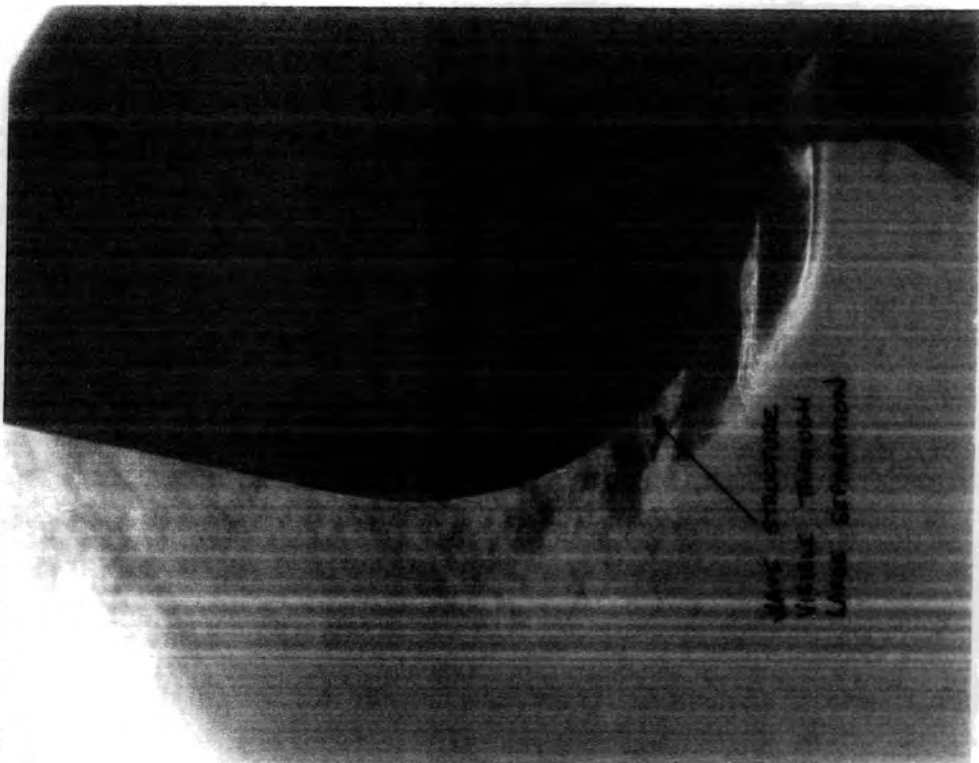


Plate 14a SLOT 3.33 STEP 0.00  
 $C_{po}$  0.174

SCHLIEREN (vke)

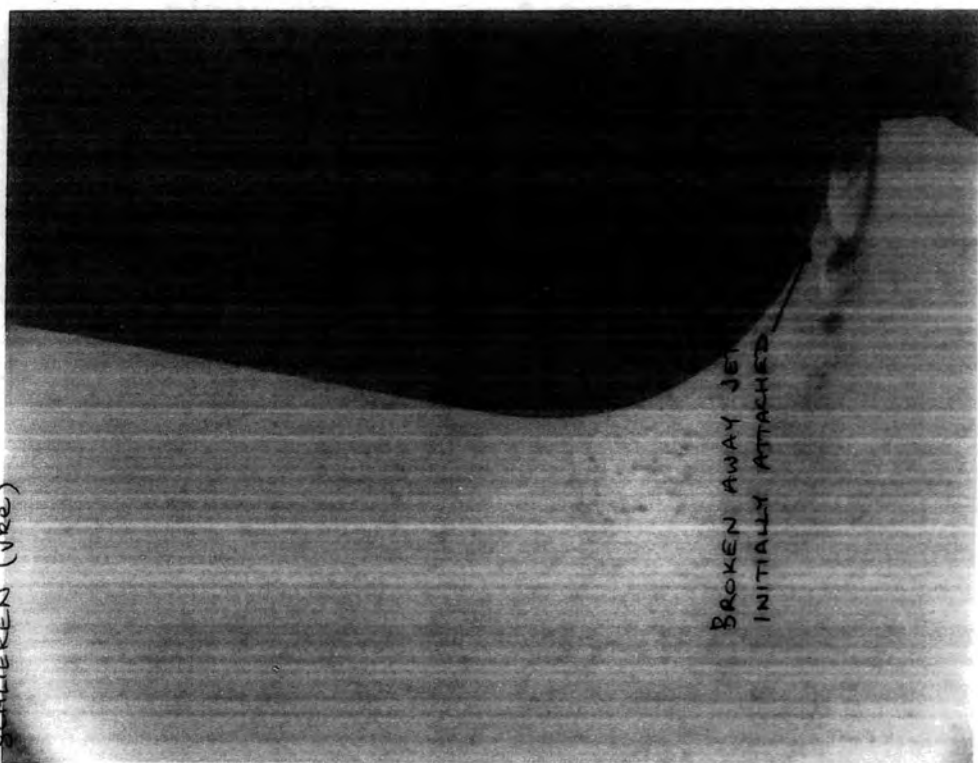


Plate 14b SLOT 3.33 STEP 0.00  
 $C_{po}$  0.243

SURFACE OIL FLOW

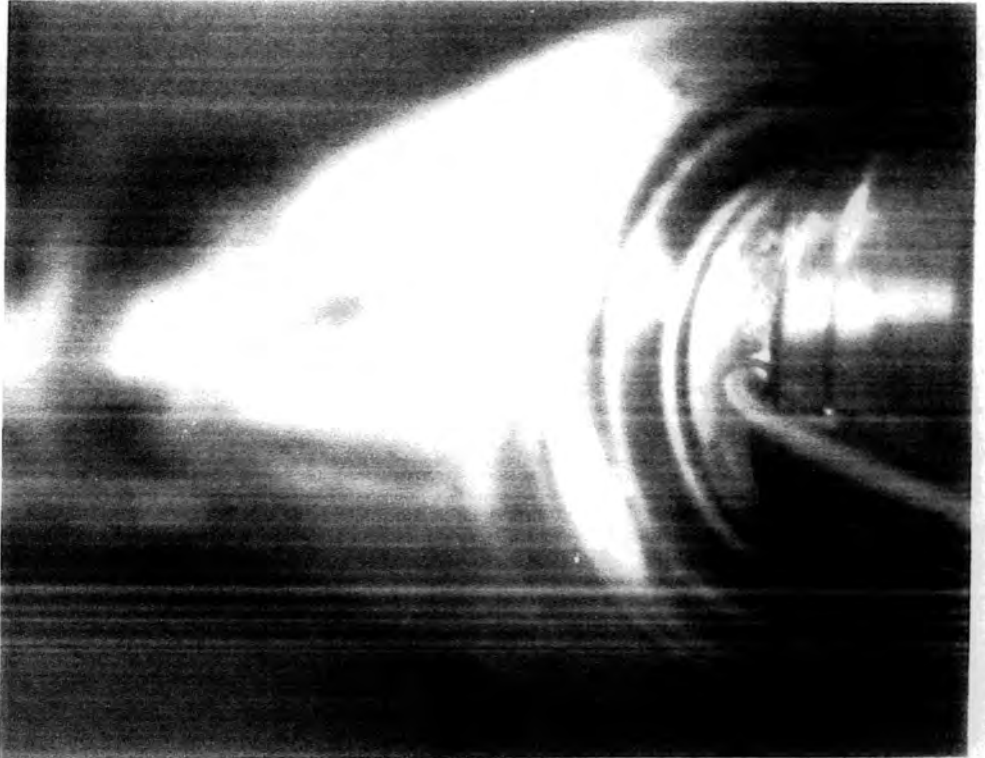


Plate 15a    SLOT 3.33    STEP 1.25  
C<sub>po</sub> 0.209

SURFACE OIL FLOW

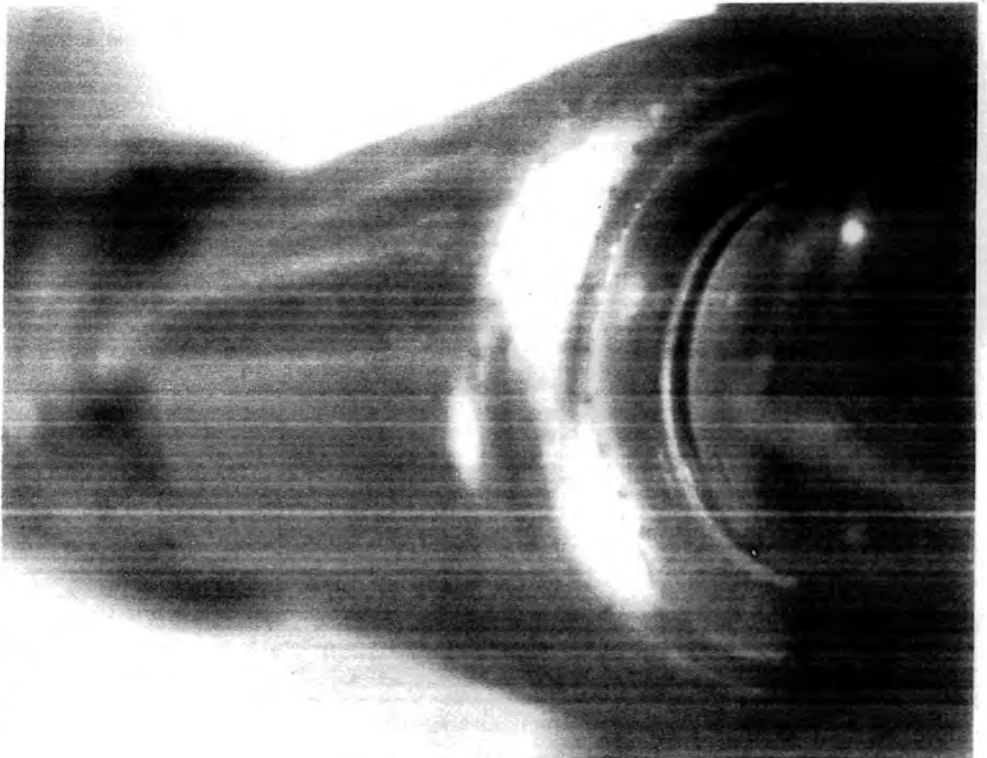


Plate 15b    SLOT 3.33    STEP 1.25  
C<sub>po</sub> 0.174

SCHLIEREN (Vire)

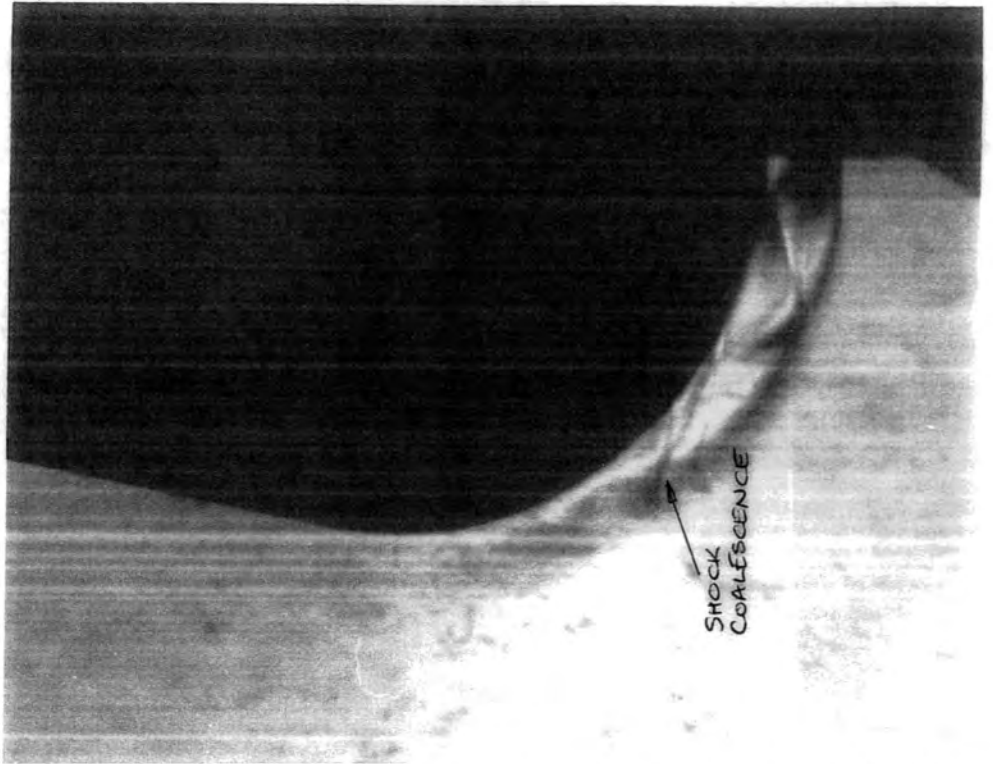


Plate 16a

SLOT 3.33 STEP 1.25  
 $C_{po}$  0.157.

SPARK SCHLIEREN (Vire)

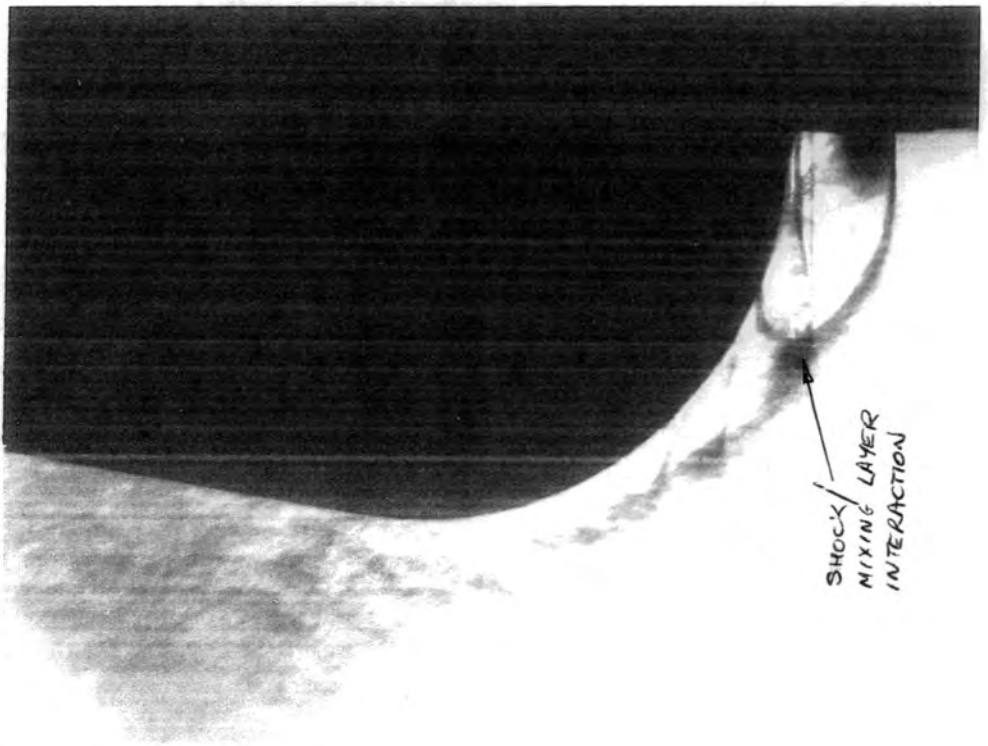


Plate 16b

SLOT 3.33 STEP 3.13  
 $C_{po}$  0.159



SCHLIEREN (Vkr)

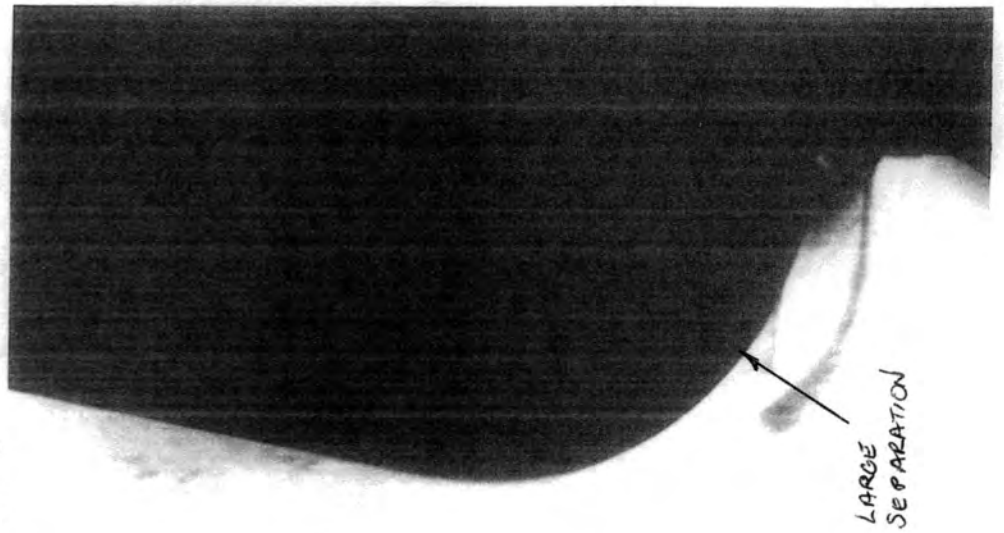


Plate 17a SLOT 5.00 STEP 0.00  
 $C_{po}$  0.225

SCHLIEREN (Vkr)

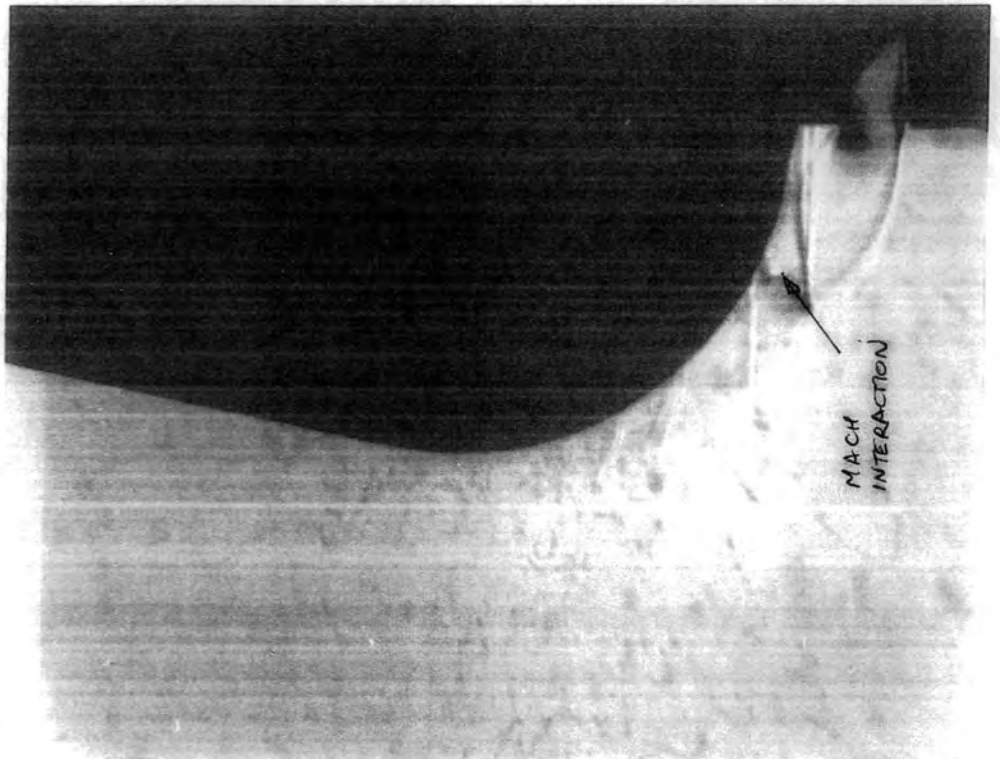


Plate 17b SLOT 5.00 STEP 3.13  
 $C_{po}$  0.222

FIELD SHADOWGRAPH

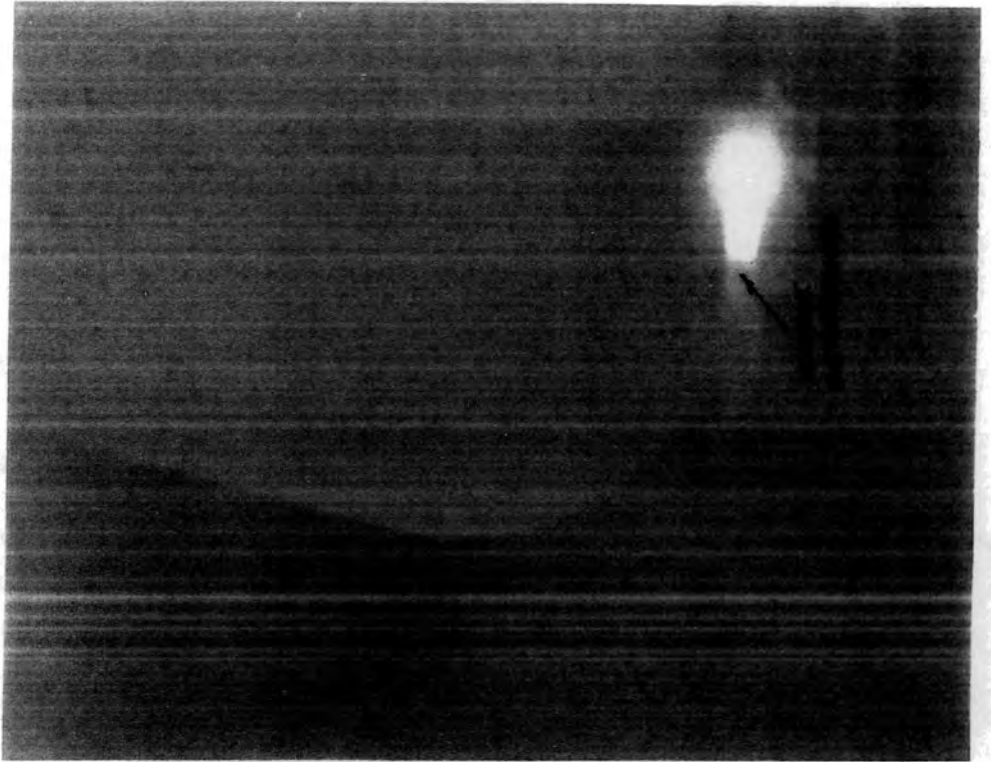


Plate 18a SLOT 6.65 STEP 0.55  
Cpo 0.252

FIELD SHADOWGRAPH

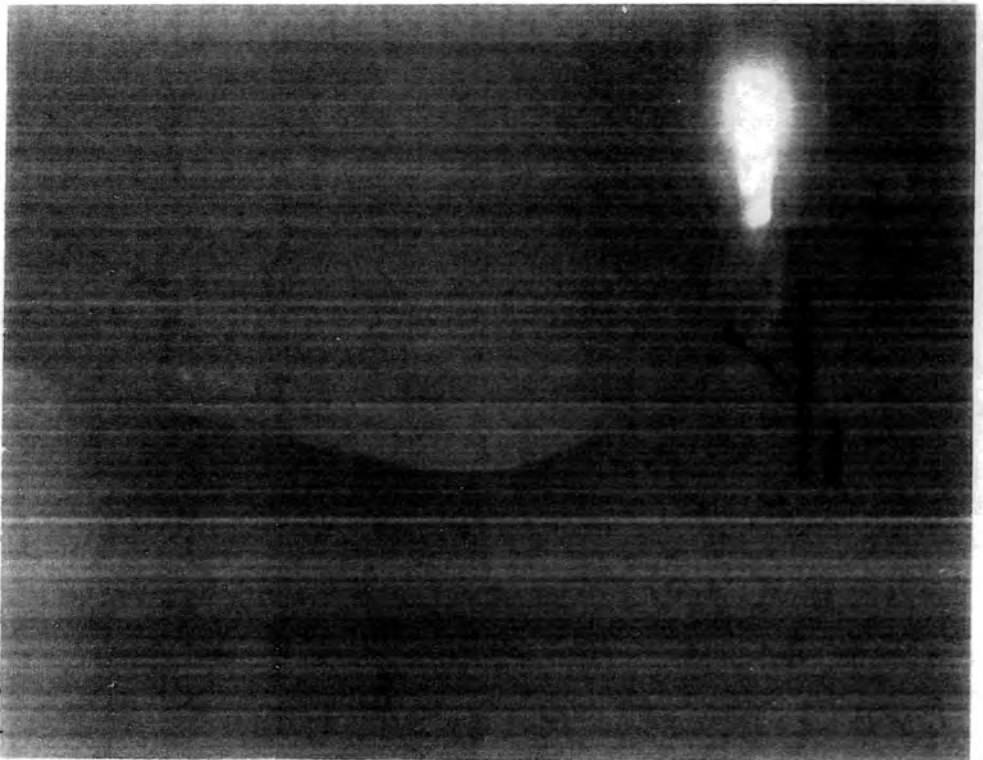


Plate 18b SLOT 6.65 STEP 3.60  
Cpo 0.184

FIELD SURFACE OIL FLOW

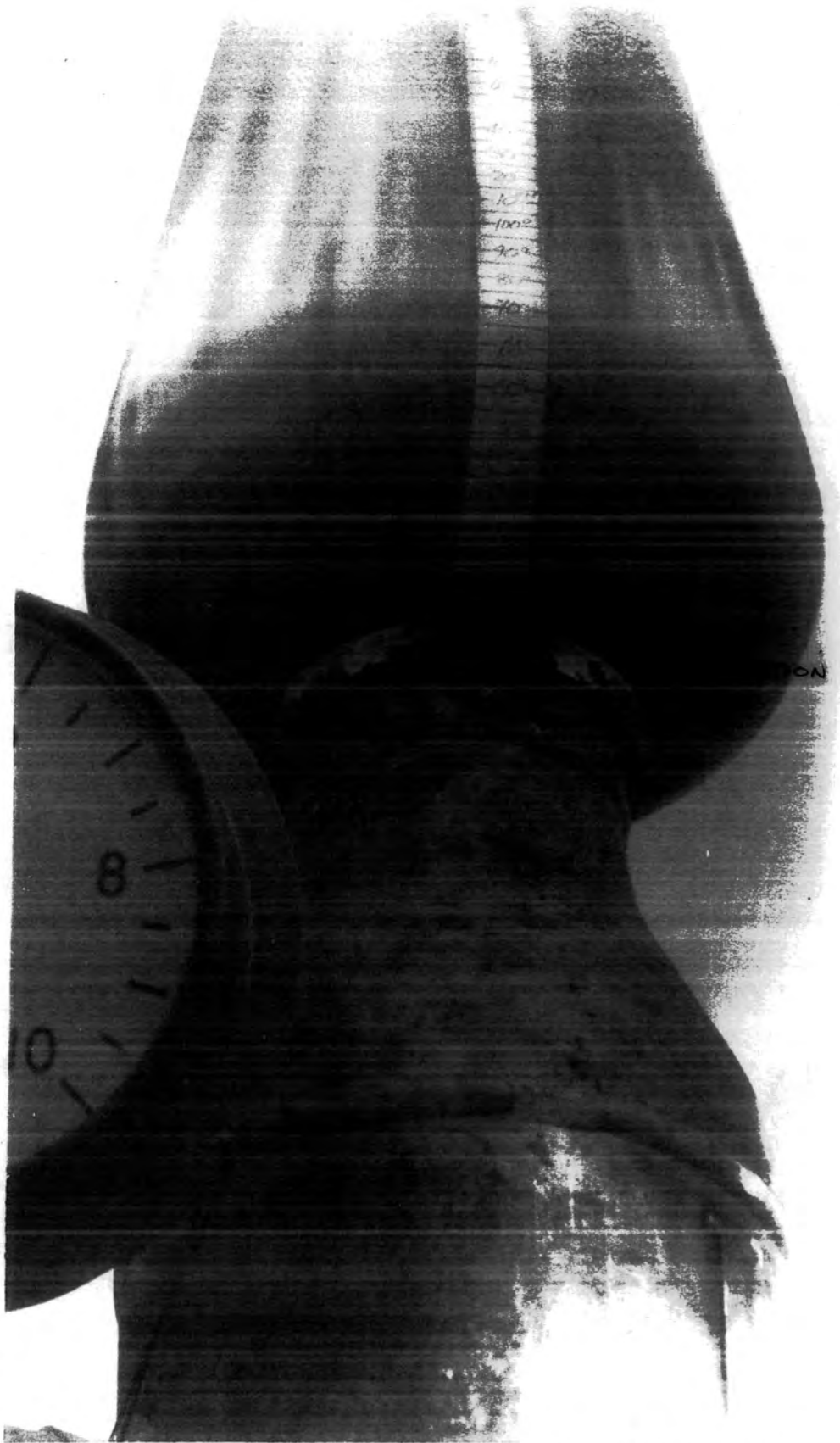


Plate 19 · SLOT 6.65 STEP 3.60  
C<sub>po</sub> 0.184